# USING APPLIED CONVERSATION ANALYSIS AND MEMBERSHIP CATEGORIZATION ANALYSIS TO STUDY STEM GRADUATE STUDENT TEACHING DEVELOPMENT

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This dissertation is dedicated to my:

Beloved family, Steven, Isaac, Iyla, and Ira, for blooming and growing with me. Always remember to bloom where you are planted. Even in the Mojave Desert seasons of your lives.

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*"If talk is cheap, then my silence is diamonds."* Lupe Fiasco

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USING APPLIED CONVERSATION ANALYSIS AND MEMBERSHIP CATEGORIZATION ANALYSIS TO STUDY STEM GRADUATE STUDENT TEACHING DEVELOPMENT

United States (US) stakeholders have advocated for increased preparation for teaching for the next generation of faculty as a key higher education reform strategy in fields of science, technology, engineering, and mathematics (STEM). It has been argued that this strategy can increase the number of skilled STEM professionals, improve scientific literacy of the US populace, and foster diversity, equity, and inclusivity within these fields. The literature about the practice and outcomes of STEM graduate student teaching development, however, has indicated that the implementation of this reform strategy varies in quality and has been understudied. This study took a novel, discursive approach to study STEM graduate student teaching development. Specifically, I combined applied conversation analysis (CA) and membership categorization analysis (MCA) to study how participants used language to co-construct social actions to achieve the practice of teaching development. Few studies have combined applied CA and MCA, thus this study also pursued methodological engagement between these two approaches to contribute to the analytic practices for characterizing the sequential and categorial organizations of social interaction. Data included 18 hours of video- and audio-recordings of face-to-face meetings for three types of teaching development: (1) a multidisciplinary STEM learning community, (2) a discipline-specific seminar, and (3) an identity-based co-curricular learning community. Disagreement was found to be a common social action co-produced by participants and shaped by the distinctive interactional contexts of each group. Notably, three forms of disagreement were found and characterized in terms of their sequential and categorial organizations: *uncontested, contested,* and *affiliative disagreements*. These disagreements served many functions, such as providing critiques, introducing moral dilemmas, questioning the feasibility of

implementing evidence-based practice, and offering support. Additionally, by combining applied CA and MCA, I identified two categorial practices involved in the co-construction of disagreements: *categorial linking* and *categorial resistance or reorganization*. This analysis made visible, at the level of language-use, how normative cultures in STEM disciplines are constructed, negotiated, and subsequently shape discourse about teaching and learning. Overall, this study contributes substantive and methodological knowledge about the production disagreements in teaching development meetings and has important implications for research and efforts to promote change in STEM higher education.

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# CHAPTER 1

# INTRODUCTION

Improving the quality of postsecondary education in science, technology, engineering, mathematics (STEM), and related fields has been an ongoing concern in the United States (US) since the 1950s. Stakeholders have advocated for various strategies to improve STEM teaching and learning and, thereby, support equitable participation in these fields, strengthen the technologically and scientifically skilled workforce, and increase the scientific literacy of the US populace (Kezar & Gerhke, 2015). As such, improving college-level teaching has become an increased focus for postsecondary STEM education reform (Henderson, Beach, & Finkelstein, 2011). In alignment with the goal of improving the quality of teaching, many researchers have sought to identify barriers to the adoption of evidence-based teaching strategies, particularly as these practices have demonstrated promise for increasing student achievement and learning within STEM disciplines (e.g., Freeman et al., 2014). More recently, scholars have advocated for increased teaching preparation for STEM graduate students as a key strategy for undergraduate education reform (e.g., Connolly, Savoy, Lee, & Hill, 2016).

Recent literature has pointed to pedagogy training for STEM graduate students as an important site to study the effectiveness of this approach for promoting instructional change in undergraduate education. Graduate students in these disciplines have often taken on significant responsibilities for teaching in introductory courses in their roles as teaching assistants, graders, discussion section leaders, and tutors, for example (e.g., DeChenne, Koziol, Needham, & Enochs, 2015). The practices for preparing STEM graduate students for these roles, however, have been underdeveloped and understudied (Austin, 2010; Connolly, Lee, & Savoy, 2018; DeChenne, Koziol, Needham, & Enochs, 2015). For instance, some researchers have generated evidence that long-term teaching development activities (e.g., year-long learning community) have been most effective for increasing the teaching self-efficacy of STEM graduate students (e.g., Connolly, Lee, & Savoy, 2018). Yet, scholars recently found that short-term training sessions (e.g., one-day workshops) were still the most common approach to teaching development for graduate students in these fields (e.g., Schussler, Read, Marbach-Ad, Miller, & Ferzli, 2015). Relatedly, studies of the effectiveness of STEM graduate student teaching development have primarily taken the form of program evaluations and investigation that used self-report data exclusively. In their evaluation of a pedagogy workshop for chemistry graduate students, for example, Bauer, Libby, Scharberg, and Reider (2013) reported increased confidence and revised beliefs about the role of instructor based on post-participation surveys. Similarly, Vergara et al. (2014) reported that 92% of participants in a future STEM faculty program were satisfied with their experience in the initiative. They also reported that participants named increased knowledge about teaching, student learning, and assessment practices as key learning gains from participation in the program. While these evaluation-focused forms of research have been important for supporting the use of teaching development interventions, these types of studies are not designed to provide insights into the actual practices and social processes involved in the training itself.

Furthermore, scholars have argued that cultural and social practices that systematically devalue teaching within STEM disciplines have been key barriers to the adoption of evidence-based teaching in higher education (e.g., Austin, 2010; Brownell & Tanner, 2012). Few studies, however, have examined the cultural and social influences on teaching development for STEM graduate students, let alone how these influences might be transformed through teaching development. Taken together, (1) the prevalent use of known-ineffective training (e.g., one-day workshops), (2) limited insights into how teaching development is actually done, and (3) minimal consideration of sociocultural influences leaves much to be desired for advocates of postsecondary STEM education reform by way of graduate student teaching development.

This study was an effort to generate evidence about the practice of STEM graduate student teaching development. Specifically, I sought to study teaching development practices that have been identified in the literature as promising practices to examine how participants in these training activities work together, *in situ*, toward the goal of instructional change in undergraduate STEM education. I drew upon two related ethnomethodological frameworks for this study: applied conversation analysis (CA) and membership categorization analysis (MCA) (Antaki, 2011; Sacks, 1972a; Stokoe, 2012a). Together these analytic approaches can make visible how social actors co-construct shared meaning, make sense of each other, and produce identities, cultures, and social realities within social interaction (Sacks, 1992; Stokoe, 2012a). I argue that STEM graduate student teaching development is done through talk and text as social actors use language to construct and negotiate culture, identities, and social realities related to teaching and learning in pedagogy training. From this perspective, language-use is a central phenomenon for illuminating the social and cultural processes involved in promoting instructional change in teaching development activities with STEM graduate students.

Additionally, while CA and MCA have a shared commitment to studying language-use, the two analytic approaches have rarely been combined to examine culture-in-interaction (Hester & Eglin, 1997; Stokoe, 2012a). With this study, I sought to contribute to the corpus of studies that combine CA and MCA for a detailed analysis of both the sequential and categorial organizations of language-use. Both CA and MCA researchers rely on past empirical studies as key resources for analyzing and characterizing practices under investigation. Therefore, this study can also provide methodological resources and insights for future studies of category-use in social interaction.

**Statement of the Problem**

Over the last 30 years, the professional development of graduate students has been an increasing focus for practitioners and researchers in higher education. Researchers have investigated a range of topics related to graduate student development, such as socialization for academic careers (e.g., Blockett, Felder, Parrish, & Collier, 2016), preparation for non-academic positions (e.g., Porter & Phelps, 2014), research skills development (e.g., Feldon et al., 2011), and training for teaching (e.g., Mutambuki & Schwartz, 2018). In her seminal work, Austin (2002) described six challenges impacting graduate student preparation: (1) calls for accountability for student learning, (2) the increasingly diverse demographics of students entering higher education, (3) innovation in technologies, (4) shifting societal expectations for academia, (5) demanding faculty roles, and (6) the competitive job market. In recognition of the changing landscape in higher education, practitioners and researchers have worked to better understand how to adequately prepare graduate students for their future roles.

Feldon, Maher, and Timmerman (2010) contrasted doctoral preparation with K-12 and undergraduate settings, noting key differences in the goals and types of assessments across levels. They argued that whereas K-12 and undergraduate learning has been oriented to uniformity, doctoral-level education has promoted specialization and novelty. In K-12 settings, for example, local and national standards have been developed to ensure that students learn the same or similar content across varying contexts. By contrast, the authors claimed that content in doctoral studies, even within the same field (or department), has often been highly variable and individualized. Feldon et al. (2010) claimed that these differences between K-12, undergraduate, and graduate-level learning contexts have manifested in educational assessments. Graded standardized tests and exams have been typical assessment formats in K-12 and undergraduate settings. In comparison, doctoral students have been required to demonstrate their unique contributions to a field with highly individualized dissertations or theses. Feldon et al. highlighted the fact that efforts to create general standards for doctoral studies, such as conceptual frameworks (e.g., Austin & McDaniels, 2006) and guidelines for performance (e.g., Lovitts, 2007), have been pursued. They argued, however, that standard frameworks have not yet been agreed upon, making it difficult to assess the quality of learning and effectiveness of preparation during doctoral education.

Austin (2002) described the learning that takes place in doctoral education – formally and informally – as a *socialization* process. Austin defined socialization as "a process of internalizing the expectations, standards, and norms of a given society" (p. 400). While many graduate students may not end up in academic positions, the process and approach to training for doctorates have often been shaped by academic norms, expectations, and values (Austin & McDaniels, 2006). Austin and McDaniels (2006) specified four main categories of doctoral competencies developed through socialization: *conceptual understanding of their work*, *knowledge and skills in areas of faculty work*, *interpersonal skills,* and *professional attitudes and habits*. A full discussion of these competencies is beyond the scope of this dissertation. It is important to note, however, that the processes through which doctoral students have been socialized to achieve these skills may vary. As Feldon et al. (2010) argued, the variability in socialization has made assessing the quality of STEM doctoral preparation a challenging task. Further, they argued that efforts to improve doctoral preparation depend on our ability to assess current practices. The challenges with assessing doctoral preparation have left researchers and mentors in a precarious position as they work to support STEM graduate students for their roles in academia and beyond.

Most pertinent to this dissertation have been the increased pressures and accountability related to student learning through institutional evaluations (Dennin et al., 2017), calls to address national workforce needs (PCAST, 2012), and efforts to reduce educational inequalities (Cheryan, Ziegler, Montoya, & Jiang, 2017). Student evaluation has been a data source that many institutions use to measure the quality of teaching and, by extension, student learning (MacNell, Driscoll, & Hunt, 2015). The importance of quality teaching and student evaluations, however, have varied in higher education. Dennin et al. (2017) highlighted the fact that evidence-based, student-centered teaching practices have still not become the norm in STEM courses at research-intensive institutions despite the abundance of research that supports these practices. They argued that this was because the value of quality teaching, as evidenced by student evaluations, and reward structures were misaligned. Specifically, Dennin et al. argued that while the *value* of quality of teaching has been signaled in policies (e.g., used in reviews for tenure and promotion), in practice, quality teaching has not been rewarded in meaningful ways. Others have drawn attention to the inadequacy of student evaluations because research has found that they inconsistently measure teaching quality (e.g., Boring, Ottoboni, & Stark, 2016) and because of evidence that student bias differentially impact scores of instructors from marginalized groups (e.g., MacNell et al., 2015). Despite their flaws, student evaluation results have remained a factor for faculty tenure and promotion and, thus, a means of institutional accountability for student learning.

On the national level, accountability for student learning has been motivated by economic, political, and workforce demands (DeBoer, 2013). The rationale for national concern about student learning has been at least twofold for STEM fields in particular. First, quality teaching and educational experiences can increase STEM degree attainment (PCAST, 2012). Second, quality teaching can improve the skills of STEM workers (Kezar & Gehrke, 2015). Therefore, it has been argued, investing in the development of effective college-level STEM educators improves both the quality and quantity of skilled workers in these fields (Connolly, Savoy, Lee, & Hill, 2016; Kezar & Gerke, 2015). This aligns with what DeBoer (2013) argued is evident throughout US policy and history surrounding STEM education reform at all levels: the goal to develop the technical and intellectual (human) resources necessary for a competitive edge in the global economy. To this end, college-level instructors have been positioned as key contributors to global economic and political competition and, therefore, became accountable to student learning as participants in achieving these national goals.

Perhaps the most pressing area of accountability for student learning has been the need for educational equity and inclusivity for the changing demographics of students. Austin (2002) argued that college instructors have increasingly worked with students who vary by age, ethnicity, gender, race, sexual orientation, and socioeconomic status among other social positions. She argued that because of increased diversity, college instructors have become responsible for facilitating equitable access to learning success for students with a range of experiences, cultures, and identities. Education researchers have argued that this has been particularly important in STEM disciplines wherein heteronormative, masculine, middle-to-upper class, western, white (among other) norms have shaped learning experiences and created exclusionary environments for students who do not align with those norms (e.g., Ong, Smith, & Ko, 2018). For example, the *underrepresented majority*, comprising gender, racial, and ethnic minorities has made up over 70% of college students, yet this group has remained underrepresented in STEM degree attainment and careers (PCAST, 2012). The disparity in the STEM workforce, as correlated with educational inequities, is consequential for the national workforce and economic possibilities for marginalized groups.

To remediate cultural and social exclusion in undergraduate STEM education, researchers have advocated for the use of evidence-based, inclusive teaching strategies, such as universal design (e.g., Rose, Harbour, Johnston, Daley, & Abarbanell, 2006), active learning (e.g., Tanner, 2013), and culturally-responsive pedagogy (e.g., Ladson-Billings, 1995). The use of active learning strategies, for instance, has been shown to improve grades for students in undergraduate science courses (Freeman et al., 2014). Similarly, Jett (2013) argued that using culturally-responsive teaching in college math courses created affirming learning environments for culturally and ethnically diverse students. College-level instructors have been charged with becoming effective facilitators of these teaching strategies to both contribute to the pipeline of scientifically and technically skilled workers and to address ongoing concerns about the inequitable access to participation in STEM fields. Thus, preparing graduate students for equity-oriented instruction has been an important avenue for addressing accountability to national workforce needs and educational inequities.

Indeed, STEM doctoral education is a critical time of preparation for future careers and roles related to meeting institutional, national, and equity concerns. It is during this time of socialization that the roles, identities, expectations, values, and norms of disciplinary members are introduced (Austin & McDaniels, 2006; Johnson, Ward, & Gardner, 2017). With ongoing calls for accountability in higher education, doctoral students and their mentors have faced important challenges with the changing landscape and demands of academia. Relevant to this dissertation, scholars have argued that the disciplinary norms, values, attitudes, and teaching-related practices introduced during early socialization into STEM fields have been consequential for later practices (Austin, 2010; Connolly et al., 2018). As it stands, STEM doctoral preparation for quality teaching is of both institutional and national interest with important implications for achieving educational equity and national goals.

Given the potential benefits of improving the quality of teaching in undergraduate education, research on how to best prepare future STEM faculty as educators is needed. The research on this topic is increasing, yet still a relatively recent focus. For instance, the first longitudinal study on STEM graduate student teaching development was conducted from 2008 to 2013 (Connolly et al., 2016). Research on this topic in the last 10 years has most often taken the form of program evaluation (e.g., Chen et al., 2017), interview studies (e.g., Goodwin, Cao, Fletcher, Flaiban, & Shortlidge, 2018), and pre- and post-participation surveys (e.g., Bauer et al., 2013). Very few studies have examined the actual practice of doing teaching development with STEM graduate students (e.g., see Stephens, Battle, Gormally, & Brickman, 2017, for an exception). Scholars have been critical of the quality of this body of research, and instructional change research more broadly, due to limited engagement with the theories and methods common to education research (Borrego & Henderson, 2014; Connolly et al., 2018; Henderson et al., 2011; NRC, 2012). Nevertheless, this area of research has grown within and across disciplines to generate evidence to support the goal of reforming undergraduate STEM education.

With this dissertation, I attempt to bring to the forefront the role of language-use in teaching development with STEM future faculty. I argue that if we are interested in understanding the transmission of values, culture, and identities as a reform strategy (Austin, 2010; Brckalorenz, 2008), then we ought to study how norms, values, culture, and identities are constructed within teaching development activities.  Language, as a medium for human action (Potter & Hepburn, 2008; Stivers & Sidnell, 2013), is a key resource through which social actors produce and reproduce values, culture, and identities (Rawls, 2002). Language-use has been given minimal attention in empirical studies of STEM graduate student teaching development (see Stephens et al., 2017, for an exception). Thus, this study was an effort to make visible the role of language-use to promote instructional change in the practice of doing teaching development with STEM graduate students.

**Study Purpose and Research Questions**

The purpose of this study was to use a novel methodological approach to study how participants promote instructional change in teaching development activities designed for STEM future faculty. Specifically, I used applied CA and MCA to examine the categorial and sequential organizations of social interactions within teaching development meetings (Chapter 3). The data included 18 hours of video- and audio- recordings of face-to-face teaching development activities from three STEM graduate student teaching development groups. After engagement with the data (see Chapter 4), I decided to focus the study on one social action: disagreement. Disagreement refers to instances when one speaker expresses a view or perspective that is counter to the view of another speaker (Sacks, 1987). During the analysis process, I found that disagreement was a social action that regularly occurred across the dataset. The rationale for focusing on disagreement for this study was twofold. First, instances of disagreement can be disruptive and may take time away from instruction if they last too long. Thus, managing disagreement is a practical concern for STEM graduate student teaching development facilitators. Second, and more importantly, given that the goal of graduate student teaching development is to encourage the next generation of STEM faculty to adopt new educational practices, it is important to examine what changes future faculty are resistant to, how disagreements manifest, and how culture is implicated in these exchanges. Examining disagreement, then, can shed light upon how participants in teaching development meetings negotiate change and work together to achieve the goal of STEM education reform. The broad question that framed this dissertation study was: *How do social actors do disagreement in STEM graduate student teaching development activities that are designed to promote instructional change in higher education?* Four sub-questions questions were developed to align with the substantive and methodological foci of the study:

1. What are the characteristics of the interactional contexts that participants co-constructed and oriented in meetings for multidisciplinary STEM, discipline-specific, and identity-based approaches to teaching development for graduate students and future faculty?
2. How are disagreement sequences produced and managed in teaching development meetings for STEM graduate students and future faculty?
3. How are categories used in the production and management of disagreement sequences in these meetings?
4. How and why did individual cases deviate – sequentially and categorially – from the general patterns of disagreement in STEM graduate student teaching development meetings?

**Significance of the Study**

While the study of STEM graduate student teaching development has increased in the last decade, this body of research has primarily consisted of studies that used self-report data, such as pre- and post-surveys for program evaluations (e.g., Chen et al., 2017), qualitative interview studies (e.g., Goodwin et al., 2018), and surveys (e.g., Connolly et al., 2018). This dissertation study introduces an alternative methodological approach that can be used to study STEM graduate student teaching development based on recordings of social interaction, *in situ*, to make visible how participants work together, moment-by-moment, to promote change in instructional practices. This methodological approach can generate detailed accounts of the institutional practices that promote, as well as constrain, new conceptions of culture, identities, and norms related to teaching in STEM. Very few studies on this topic have included analyses of social interaction or discourse (see Miller, Brickman, & Oliver, 2014, for an exception) in graduate-level teaching development activities in STEM. Thus, this adds to the science education literature base of empirical studies of social interactions and discourse in STEM graduate student teaching development meetings. This study also generates new knowledge about disagreements based on observations of STEM graduate student teaching development practice.

Methodologically, this dissertation adds to the corpus of studies that combine CA and MCA for sequential analyses of culture-in-interaction (Hester & Eglin, 1997; Stokoe, 2012a). Stokoe (2012b) called for further development of MCA, as well as increased engagement between CA and MCA for studies of *categorial systematics*. Categorial systematics, which is discussed in detail in Chapter 3, attends to the sequential organization as traditional CA does, and also considers how the categorial organization of social interaction produces particular cultures, identities, and social realities that shape interactional trajectories. This study is an effort to work through methodological challenges and possibilities with studying categorial systematics.

## Definition of Terms

Below are key terms that have been referenced throughout this dissertation. Upon reading the literature, I recognized varied definitions of similar terms. For the sake of clarity, my orientations to these terms are provided below.

**Categorial systematics:** Stokoe (2012a) argued that in comparison to CA, MCA has not established sets of findings or fundamental descriptions of how social actors produce categories *as given* within social interaction. In articulating the possibility of doing so for MCA, Stokoe (2012b) advocated for analyses that address both category and sequence organization for *categorial systematics* (contrasted with "simplest systematics" in CA, p. 353). I use categorial systematics to describe the structured ways through which social actors use categories to produce culture, identities, and how categorization practices mutually shape interactional trajectories (Stokoe, 2012a, 2012b).

**Conversation analysis**: CA is a distinctive qualitative research approach that examines how social actors produce shared meaning and social life through talk-in-interaction (Sacks, 1992). CA initially was developed in the field of sociology by Harvey Sacks, Emmanuel Schegloff, and Gail Jefferson in the 1960s and served as a novel approach to researching conversational interaction. The theory and method of CA were significantly influenced by Harold Garfinkel's ethnomethodology (Garfinkel, 1967) and Erving Goffman's concept of the interaction order (Goffman, 1983), as well as various fields social and behavioral inquiry. At its core, CA is concerned with how talk-in-interaction (defined below) is sequentially organized to produce social actions. Through analysis of social interaction, analysts seek to describe how social actors use language to perform actions (e.g., persuade, question, etc.) and how language is built to perform specific actions (Sacks, 1984). The epistemological commitments of CA researchers vary (Atkinson, 1988, discussed further in Chapter 3). I orient to CA as aligned with micro-social constructionism (Lester & O'Reilly, 2019) for its attention to how social life is produced *as given* through microinteractional sites of construction (e.g., face-to-face interaction) in the routine activities in everyday life (Gubrium & Holstein, 2008).

**Disagreement:** I use the term disagreement to refer to moments one speaker expresses a view that is different or counters the view of another speaker (Sacks, 1987; Sifianou, 2012).

**Future STEM faculty**: The term future STEM faculty is used variably in the literature to describe graduate students (i.e., masters and doctoral students), doctoral students, postdoctoral scholars, or those interested in pursuing careers in academia. Future STEM faculty is used in this dissertation to describe each level of scholar that could be a candidate for future faculty positions. Instances that refer to specific levels (e.g., doctoral students) are noted.

**Instructional change strategies**: The instructional change strategies framework was developed by Henderson et al. (2011) to describe the various approaches to undergraduate STEM education reform. Upon review of the literature, the authors found four core strategies: (1) *Disseminating Curriculum and Pedagogy,* (2) *Developing Reflective Practitioners*, (3) *Enacting Policy,* and (4) *Developing Shared Vision*. They also found that three distinct communities were engaged in research on instructional change: (1) discipline-based (2) faculty development researchers, and (3) higher education researchers. Henderson and colleagues drew attention to the fact researchers in these three distinct communities had very little cross-disciplinary engagement. While I do not draw upon this framework to define the research conducted for this study, this terminology is used to situate this study of STEM graduate student teaching development in multiple research communities.

**Membership categorization analysis**: Sacks' (1972a, 1972b, 1979) early writings about category use formed what is now known as MCA. MCA is an ethnomethodological approach developed from Sacks' (1972a, 1972b) early interest in the ways in which social actors use categories (e.g., scientist) and through them produce particular social realities, identities, and cultures. While CA and MCA were both developed from studies conducted by Harvey Sacks and colleagues, the development of CA was pursued more than MCA (Stokoe, 2012a). Maynard and Clayman (2003) described membership categorization as an "eclectic" interest of Sacks (p. 193). Hester and Eglin (1997) also highlighted inconsistencies in Sacks' writings about categories compared to some of the core principles of CA research. They noted that Sacks often wrote about categories as seemingly pre-given compared to his CA writings wherein social meanings were conceived of as contingent and produced *as if* they were stable. In keeping with a commitment to micro-social constructionism, I oriented to categories as produced and reproduced in routine activities of everyday life rather than pre-given. MCA is used to emphasize language-use for producing categories and to make visible how social actors achieve categorization. My orientation to MCA is discussed further in Chapter 3.

**STEM:** How to define science, technology, engineering, and mathematics is of scholarly interest in many fields of inquiry, such as of philosophy (e.g., Chalmers, 2013), science technology and society studies (e.g., Cipolla, Gupta, Rubin, Willey, 2017), and science education (e.g., Akerson et al., 2018). The term STEM (previously SMET) was initially developed as a unified concept in the 1990s to covey similar disciplinary norms and shared commitment to the use of scientific method to produce knowledge within fields of science, technology, engineering, and mathematics (Chesky & Wolfmeyer, 2015). STEM has also been used to signal to the inherent interdisciplinarity of these fields (Breiner, Harkness, Johnson, & Koehler, 2012). More recently, STEM has been defined variably by federal agencies (e.g., Department of Homeland Security (DHS), National Science Foundation (NSF)) in alignment with their organizational goals (Gonzales & Kuenzi, 2012). The mission of the NSF, for instance, has been to support and fund research and education in fields of science and engineering (excluding medical sciences) to contribute to the prosperity, health, and security of the US (NSF, 2019). These fields have included: (1) biological, agricultural, and environmental life sciences, (2) computer and mathematical sciences, (3) physical sciences, (4) social and behavioral sciences, (5) engineering (NSF, 2018). By contrast, the DHS (2016) included (1) engineering, (2) biological and biomedical sciences, (3) mathematics and statistics, and (4) physical sciences in their list of approved STEM disciplines; its mission has been to support efforts to improve national security. The complexity of what counts as STEM will not be settled here. However, it is important to draw attention to the fact that what has come to count as STEM has not been static since its conception in the 1990s. In the literature reviewed for Chapter 2, the fields included in STEM varied. For instance, some scholars used STEM to describe natural sciences, physical sciences, and engineering, excluding social and psychological sciences (e.g., DeChenne et al., 2015). Others followed the NSF definition and included participants from social sciences as part of the intended audience of future STEM faculty development efforts (e.g., Vergara et al., 2014). Many of the large-scale STEM graduate student teaching development initiatives also used the NSF definition (e.g., CIRTL, 2019). For the purposes of writing and consistency, I used NSF's broad definition of STEM as many graduate student teaching development initiatives were designed to target the disciplines NSF has outlined. Within the context of data analysis and in alignment with the methodological approach that is used for this study, I will defer to how social actors variably construct STEM. I argue that what comes to count as STEM within the routine activities of doing teaching development is a phenomenon of interest in and of itself.

**Talk-in-interaction**: The term talk-in-interaction is used to refer to the object of study in conversation analytic research. Schegloff (2007a) argued that the term conversation did not adequately capture CA's focus on the study of the organization of talk in naturally occurring interactions. The use of talk-in-interaction, as a form of *language-in-use*, is an effort to be more inclusive of forms of interaction and speech exchange that do not fit under the category of "conversation" (e.g., computed-mediated communication). The term talk-in-interaction de-emphasizes individual actors and instead focuses on how language is used as the object of interest for studies of social interaction. *Language-in-use* (Button & Lee, 1987) and *language-use* are used interchangeably with talk-in-interaction and talk respectively to be more inclusive of non-verbal communicative conduct (e.g., gaze, gesture).

**Teaching development**: Connolly et al. (2018) defined teaching development as "helping doctoral students gain the knowledge, skills, and values needed to effectively teach undergraduates" (p. 2). Throughout this dissertation, teaching development is used to describe any activities (e.g., workshops, learning communities, etc.) that support STEM graduate students to learn the knowledge, skills, and values for effective teaching.

## Motivation

My interest in college-level teaching in STEM began during my undergraduate studies as a biology major. All of my professors in STEM courses provided standard lectures with PowerPoint slides, except for one professor who taught introductory genetics. That professor taught using what I now know to be active learning strategies, introduced historical and cultural contexts within content-focused lectures, and made strong links between science and society.

Learning in that one genetics course was compelling and encouraged my later efforts to conduct genetics research as an undergraduate. It also placed in my purview the fact that women and people of color faced significant obstacles to pursue advanced degrees in STEM disciplines and rarely had their scientific contributions recognized. This idea became more close to home when I observed that my higher-level science and math courses enrolled fewer and fewer women and students of color.

During this time, I tutored peers in biology and chemistry. I wanted to learn more about how to tutor in a way that was effective for learning. Following my genetics professor's model, I tried out think-pair-share activities and shared facts about scientists of color in peer tutoring groups. Whether my early attempts to use culturally relevant pedagogy (Ladson-Billings, 1995) in science were effective or done well is unknown. Nonetheless, I remembered how excited my peers were to learn a different way. We wondered why our science professors, teaching assistants, and other instructors did not teach the way my genetics professor did. To learn more about this, I met with several of my science professors to find out about their career pathways and how they learned how to teach in their discipline. Each of them told me that they had no formal training in teaching, except my genetics professor.

My interest in teaching professional development for college-level teaching in STEM was further developed during doctoral studies in two graduate assistantships. In the first assistantship, I worked for a STEM program for first-generation and minoritized students. Though my role was primarily to support program participants to navigate STEM majors and career pathways, many of the concerns for these students centered on questions about how to learn in their courses and how to cope with teaching practices they characterized as unhelpful for learning. In the second graduate assistantship, I led and facilitated activities to support STEM graduate students to learn how to teach. These activities were based on the premise that preparation for teaching during graduate studies would support the next generation of STEM faculty to be effective instructors (Austin et al., 2009; Pfund et al., 2009). As a facilitator of STEM teaching development, I read empirical studies to learn about best practices for supporting graduate students (e.g., Sandi-Urena & Gatlin, 2013; Vergara et al., 2014). Notably, I learned that despite the abundance of evidence of positive outcomes from evidence-based teaching (e.g., Freeman et al., 2014), the widespread adoption of these practices in STEM disciplines has been slow (Brownell & Tanner, 2012; Connolly et al., 2018). The slow uptake of evidence-based teaching alongside the potential benefits for equity warranted the need to invest in better preparation for future STEM faculty. Investing in preparing the next generation of faculty for me meant that more students who have typically been excluded in STEM (e.g., by ability, culture, gender, race) would benefit from college instructors who would be able to facilitate inclusive, effective learning environments. Thus, this study was primarily motivated by a desire to understand *what works* to improve teaching for equitable access to success and participation in STEM.

Methodologically, I became interested in CA and MCA through my curiosity about language. Throughout my educational journey, I read Audre Lorde (1984) and Fanon Franz (1967), both of whom drew attention to the relationship between language and how we experienced the social world. These writings influenced my view of the world and inspired me to pay attention to words and what words do, particularly in learning environments. O'Reilly and Kiyimba (2015) have argued that our worldviews shape our research interests, the theories we select, and the methodological approaches we draw from. Given my interest in language, I explored various approaches to discourse analysis to better understand how words shape our experiences and vice versa. Through coursework and readings in research methodology, I was drawn to the ideas of Garfinkel's (1967) ethnomethodology and his theorizing about the ways in which members of society *actively* work together to produce social life rather than experience the world as passive participants. Garfinkel and Sacks (1986) argued that everyday life, including scientific research, were both achieved through language use. CA, MCA, and other ethnomethodological research approaches (e.g., discursive psychology, Edwards & Potter, 1992) offered me useful resources to analyze how actors use language to produce social life in the fine-grain details of actual events. I made connections between my methodological interests and the possibility to learn how one instructional change strategy is done through studies of language-use. Importantly, I realized that CA and MCA could be used to provide evidence for how undergraduate STEM education could be produced as more equitable, inclusive, and just. To this end, I was motivated by a desire to understand how participants use language to *do* teaching development and how these activities might be designed to improve practice. In summary, this dissertation brings together a commitment to improving undergraduate STEM education, my worldview that emphasizes the importance of language-use, as well as theoretical and methodological resources toward the goal of informing the design of effective graduate student teaching development activities.

**Organization of the Dissertation**

This dissertation is organized into eight chapters. Following this introductory chapter, Chapter 2 is a literature review of the empirical studies of graduate student teaching development in STEM fields. In the first part of this second chapter, the research on this topic is situated within the broader discussion of instructional change strategies to reform undergraduate STEM education. This broader context shapes the format of teaching development activities for graduate students, as well as the forms of research conducted on these practices. The second part of Chapter 2 is a thematic analysis and synthesis of empirical studies. Overall, this chapter builds a case for using the proposed methodological approach based on gaps in the literature and knowledge about STEM graduate student teaching development.

Chapter 3 describes the theoretical commitments and orientation to CA and MCA. As ethnomethodological research approaches are less frequently used in science education (Roth, 2013), this chapter was necessary to outline the key theoretical ideas and conceptual resources of CA and MCA. I began the chapter with a discussion of the field of ethnomethodology. Ethnomethodological principles undergird the theory and method of CA and MCA and, therefore, warranted an introduction to Garfinkel's (1967), albeit abbreviated. The next two sections of Chapter 3 described CA and MCA, followed by a constructive critique of ethnomethodological research more broadly. These previous sections set the stage for me to conclude the chapter with a discussion of my theoretical commitments and imaginings for the methodological contributions of this dissertation.

In Chapter 4, I detail the methodological approach, research procedures, and analytical practices for the study. I present a detailed description of the three STEM graduate student and future faculty teaching development groups that were included in the study: (1) a multidisciplinary STEM learning community, (2) a discipline-specific journal club seminar, and (3) an identity-based co-curricular learning community. I drew upon the EMCA literature base to describe how findings were generated and warranted.

The next three chapters present the findings of the study. In Chapter 5, I analyze and compare the distinctive interactional contexts and environments for the three groups in the study. To do this, I describe four interactional features: (1) overall structural organization of meetings for each group, (2) the rates of disagreement to compare the frequencies by group (3), activities preceding disagreements, and (4) analysis of participants' orientations to their institutional setting and roles. Chapter 6 presents the findings from the sequential and categorial analyses of disagreements. The chapter begins with an orientation to the general features disagreement, a brief introduction to Brown and Levinson's (1987) politeness theory, and a consideration of how interactional contexts shape the production of disagreements. Next, I describe two candidate categorial systematic practices that were identified through the analysis of disagreements: (1) *categorial systematics* and (2) *resistance to or reorganization of prior categorizations*. Following this, I describe three forms of disagreement: *uncontested*, *contested*, and *affiliati*ve. In Chapter 7, I share the analysis of three deviant cases of disagreements.

In Chapter 8, I conclude the dissertation with a comprehensive summary of findings, as well as a discussion of implications for science education research, research methodology, and teaching development practice. Finally, the dissertation is concluded with a discussion of future research.

**Chapter Summary**

This chapter provided an introduction to the broader context and problems related to the preparation and socialization of STEM graduate students for their roles as college-level instructors. I argued that a study of language-use is needed to better understand how participants in STEM future faculty teaching development work together to shift the culture and practice of teaching and learning in higher education. Following this, I described the study purpose and research questions, introduced key terms, and shared motivations for the study. To support the reading of this dissertation, I then provided an overview of the organization and contents of the remaining chapters. In the next chapter, I present a review of the empirical literature on STEM graduate student teaching development.

# CHAPTER 2

# REVIEW OF RESEARCH ON TEACHING DEVELOPMENT FOR GRADUATE STUDENTS IN STEM FIELDS

## Chapter Overview

The purpose of this chapter is to provide a review of the empirical literature related to graduate student teaching development in science, technology, engineering, mathematics (STEM), and related fields. After a brief overview of the search method, I discuss the instructional change strategies framework in postsecondary STEM education reform (Henderson et al., 2011) that was used to situate this review. This is followed by a thematic review of the empirical literature. Finally, I provide a discussion of the key features, strengths, limitations, and gaps in the current empirical base.

## Literature Search Method

I delimited this search to the period of 1990 to 2018 to include literature when the category *STEM* was created along with government-sponsored educational initiatives to promote participation in these fields (Chesky & Wolfmeyer, 2015). It was also during this time-period that discipline-focused discussions about teaching development were also increasing in STEM fields (Connolly et al., 2018). I then further defined the scope of the review by focusing on five bodies of literature relevant to STEM graduate student teaching development: (1) future faculty development, (2) graduate teaching assistant training, (3) graduate student socialization, and (4) professional development, and (5) postsecondary STEM education reform. This focus was to make sense of (1) common issues and strategies to improve postsecondary STEM education, (2) general approaches to teaching and professional development for graduate students and future faculty, and (3) research related to teaching development for STEM graduate students and future faculty. Next, I conducted targeted searches to find discourse analysis and conversation analysis (CA) studies of STEM graduate student and future faculty development to find works with similar methodological approaches to the one I propose. Variations of the following search terms were used to locate sources: “graduate students or doctoral students or masters students”, “science, technology, engineering, and mathematics”, “teach*”, “teaching assist*”, “teaching development”, “professional development”, “socialization”, “chemistry”, “biology”, “physics”, “geology”, “astronomy”, “health”, “medicine”, “STEM education reform”, “discourse analysis”, and “conversation analysis”. The following databases were searched with the support of a librarian using the aforementioned terms: OneSearch@IU, Google Scholar, and ProQuest Dissertations and Global Theses. Additional sources were identified by reviewing reference lists. From this initial search, I found 336 sources including research articles, books, chapters, conference papers, dissertations, reviews, organizational reports, news articles, and position papers.

To narrow the literature for this review, I read abstracts and selected only sources that focused on STEM graduate student and future faculty development. This yielded 144 sources. Because one of the goals of this dissertation is to consider what conversation analysis (CA) and membership categorization analysis (MCA) studies can offer to the study of STEM graduate student and future faculty teaching development, I focused this review only on empirical studies and drew upon remaining literature to frame this review. Of the initial sources, 78 were empirical studies related to STEM graduate student *teaching development* specifically, comprising 53 journal articles, 15 dissertations, seven organizational reports or publications, two conference papers, and one book chapter. To analyze the empirical literature, key ideas and arguments were documented and coded while attending to the following features (Lester & O’Reilly, 2019):

- Source type (e.g., journal article, book chapter, dissertation)
- Type of research (e.g., original research, program evaluation)
- Data and data collection methods (e.g., interviews, pre/post surveys)
- Methodology
    - Research design (e.g., case study)
    - Research or evaluation questions
    - Study purpose or evaluation aims
    - Mixed method(s), qualitative, quantitative
    - Data and data collection methods
    - Philosophical and theoretical perspectives, concepts, and framing (e.g., self-efficacy, community of practice)
- Key findings and implications

Reading and coding notes for this review were managed using ATLAS.ti, a qualitative data analysis software, and Google Drive. I orient to this review is a selective and partial reading of the literature.

**Instructional Change Strategies and the Role of College-Level STEM Educators**

As described in Chapter 1, effective teaching in undergraduate STEM education has been promoted as an important way to address US workforce needs and equity concerns. Researchers found that women and minoritized groups have been marginalized within STEM learning environments (Chang, Sharkness, Hurtado, Newman, 2014; Ong, Smith, & Ko, 2018; Wilkins-Yel, Hyman, Zounlome, 2019). Additionally, ineffective teaching practices (e.g., extended lectures) have continued to be used in undergraduate STEM courses (Dennin et al., 2017). As such, scholars have advocated for equity-oriented, inclusive teaching to diversify STEM participation (e.g., Dewsbury, 2017), as well as the use of evidence-based teaching to improve learning gains for all students (e.g., Freeman et al., 2014). Four recommendations related to postsecondary instructional change were included in two national reports on STEM education: The President's Council of Advisors on Science and Technology (2012) report, *Engage to Excel*; and the National Research Council's (2012) report on discipline-based education research:

- "Adopt teaching strategies that emphasize student engagement." (PCAST, 2012, p. 8)
- "…work together to prepare future faculty who understand the findings of research on learning and evidence-based teaching strategies, and who value effective teaching as part of their career aspirations." (DBER, 2012, p. 198)
- "…a deliberate focus on changing faculty conceptions about teaching and learning, recognize the cultural and organizational norms of the department and institution, and work to address those norms that pose barriers to change in teaching practice." (DBER, 2012, p. 3)
- "…require all graduate students and postdoctoral fellows supported by federal training grants to receive instruction in modern teaching methods." (PCAST, 2012, p. iv)

The recommendations above can be linked to change strategies described in Henderson et al.'s (2011) seminal review of studies on instructional reform in postsecondary STEM educational settings. In their review of 191 articles, the authors identified four common change strategies enacted in undergraduate STEM education: *Disseminating Curriculum and Pedagogy, Developing Reflective Practitioners*, *Enacting Policy*, and *Developing Shared Vision* (Figure 1). The national recommendations above aligned with efforts to disseminate pedagogy (e.g., engagement-focused teaching) and implement policy (e.g., required teaching training), though the connections to fostering a shared vision and developing reflective practitioners and were less clear.

Figure 1

*Instructional Change Strategies for Undergraduate STEM Education Reform*

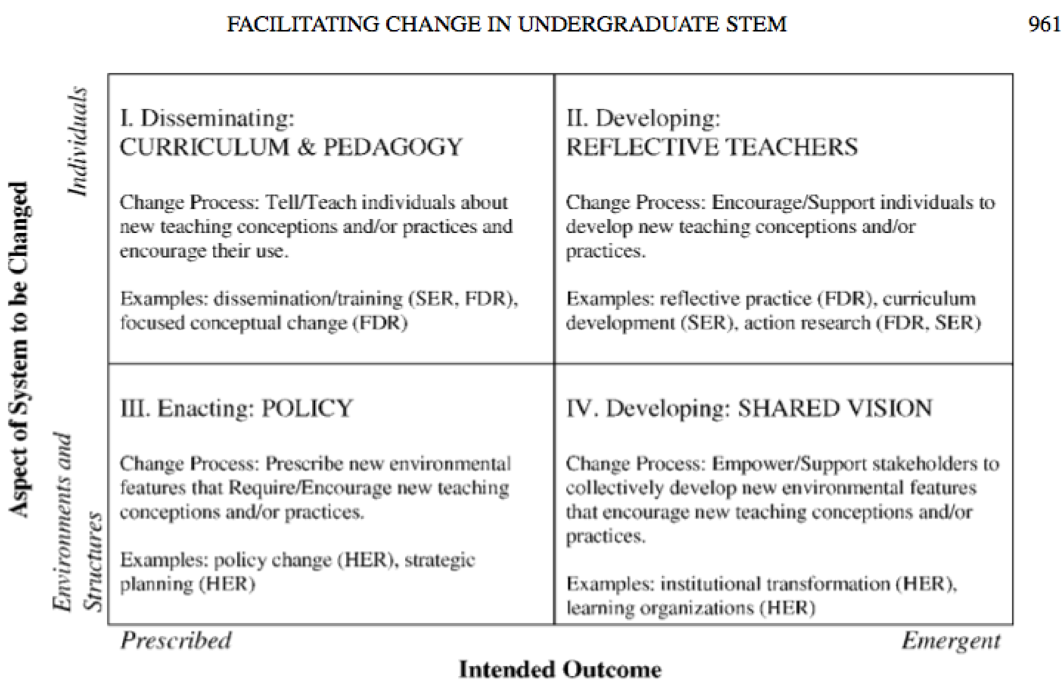



Figure 1. A conceptualization of the reform strategies promoted and used in faculty development, higher education, and science education communities. Reprinted from "Facilitating Change in Undergraduate STEM Instructional Practices: An Analytic Review of the Literature," by C. Henderson, A. Beach, A., and N. Finkelstein, 2011, *Journal of Research in Science Teaching*, *48*(8), p. 961. Copyright 2015 by John Wiley and Sons. Reprinted with permission.

College-level instructors, however, were the explicit focus of at least two instructional change strategies: *Disseminating Curriculum and Instruction* and *Developing Reflective Practitioners*. The two primary categories of instructors targeted for change included faculty and graduate students. Of note, researchers have drawn attention to the increasing reliance on adjunct or other temporary instructors for teaching introductory undergraduate courses (Nica, 2018). This has been particularly relevant to national calls to transform the first two years of STEM undergraduate education for which adjunct instructors have been increasingly responsible for (PCAST, 2012; Gehrke & Kezar, 2017). Nevertheless, the rationale and barriers described across the literature have focused on faculty and graduate students as key actors in undergraduate STEM education reform.

STEM faculty instructors have been identified as the ideal group to target for instructional change. They have typically been responsible for designing the course curriculum and oftentimes had the agency to implement innovations. Thus, faculty have been considered well-positioned to contribute to instructional change. Researchers have identified four common factors that have shaped faculty decisions to improve teaching: (1) rewards structures (e.g., institutional awards, funding), (2) the relative importance of teaching and research within the institution, (3) institutional emphasis on winning research funds, and (4) traditional teaching practices within disciplines and departments (Austin, 2010; PCAST, 2012). Promoting instructional change among faculty, however, has been met with challenges. Institutional reward systems have often been more weighted toward research activities at the expense of teaching. For example, teaching release has sometimes been awarded so that faculty can focus solely on research (Anderson et al., 2011). Additionally, teaching-related publications and awards have not been traditionally treated as valuable forms of recognition within scientific communities (Brownell & Tanner, 2012). It is within these institutional and disciplinary norms and practices that teaching has been systematically devalued.

Rather than positioning teaching as an integral part of being a scientist, scholars have argued that teaching has been treated as an add on or extracurricular interest by institutions and members of disciplinary communities (Anderson et al., 2011; Brownell & Tanner, 2012). This has been compounded by the fact that many faculty are unfamiliar evidence-based education practices in part because it has not been conventionally part of the doctoral curriculum, especially in STEM disciplines (Austin et al., 2009; Golde & Dore, 2001). Subsequently, large-scale faculty teaching development efforts, such as Project Kaleidoscope and BioQUEST, have been implemented to promote conceptual change about teaching among STEM faculty and to support the use of research-based teaching in undergraduate learning settings (Kezar & Gehrke, 2015). Despite these efforts, faculty have remained the least likely group of college-level instructors to use evidence-based education practices due to limited time, lack of incentives, limited motivation to pursue teaching-focused professional development, and/or limited opportunities to develop teaching (NRC, 2012). Graduate student instructors have been identified as a secondary group to consider for instructional change efforts given the potential constraints with changing the practices of current faculty.

Like faculty, graduate student instructors have played a significant role in introductory courses for undergraduate STEM majors and non-majors. Graduate students have often served as teaching assistants, lab instructors, and discussion leaders with generally more interactions with students than faculty (Rushin et al., 1997; DeChenne et al., 2012a; Gardner & Jones, 2011). At research institutions in the US, for instance, over 90% of biology laboratory instruction at research-intensive institutions has been led by graduate teaching assistants (Sundberg, Armstrong, & Wischusen, 2005).  Unlike faculty, graduate students have often had limited support or agency to implement a new curriculum or innovative teaching practices. Congruent with this, in Goodwin, Cao, Fletcher, Flaiban, and Shortlidge's (2018) interview study, researchers found that even if biology graduate instructors were in favor of using evidence-based teaching, they were still unlikely to implement these strategies due to limited opportunities or support to do so. Graduate student instructors have also received mixed messages about the importance of teaching in STEM disciplines and have often been discouraged from pursuing teaching professional development (Austin & McDaniels, 2006; Stowell et al., 2015). On the one hand, developing teaching practice has been encouraged to promote flexibility in career pathways (Connolly, Savoy, & Lee, 2016). On the other hand, time spent on teaching-related activities and its impact on degree completion have been looming concerns for doctoral advisors (Tanner & Allen, 2006). As Ciacca (2011) argued, scientists have, at times, characterized teaching as "a "zero-sum" activity that detracts from the cutting-edge research that provides them with grants and recognition" (p. 212). These competing messages have produced uncertainty and tensions among graduate students about how they should invest their time as related to their current and future roles.

In light of ambivalence toward teaching in STEM fields, scholars have sought to describe the potential benefits of teaching professional development during graduate studies. Feldon et al. (2011), for instance, generated evidence that developing teaching skills were correlated with improved disciplinary research skills. In another study, Connolly (2012) found that about half of STEM graduate students end up in teaching roles upon degree completion. These studies provided evidence for the value of teaching development and could alleviate common concerns among faculty advisors about how students spend their time. Example concerns from advisors included the potential for distraction from research training and increased time to degree, both of which were mostly unfounded in empirical studies of graduate students' participation in teaching development activities (Tanner & Allen, 2006; Connolly et al., 2016; Connolly et al., 2018). Accordingly, it may be the case that the benefits of teaching development during graduate studies outweigh the potential drawbacks.

Another reason that has been given for targeting graduate students for STEM education reform, Kezar and Gehrke (2015) argued, “they do not have deeply ingrained habits or allegiances to the status quo” (p. 75). From this view, graduate students have been positioned as ideal change agents to unsettle traditional practices. This claim implied that investing in teaching development during doctoral education can shape the future of the teaching practices in these fields, which is consistent with arguments that early career development shape later practice (Austin & McDaniels, 2006; Bess, 1978; Connolly et al., 2016). Following this logic, various future faculty development programs have been designed and implemented to reform undergraduate STEM education. The Center for the Integration of Research, Teaching, and Learning (CIRTL), for example, is a multi-institutional network that seeks to transform undergraduate STEM education through the professional and educational development of future faculty (i.e., graduate and postdoctoral scholars) (CIRTL, 2019). CIRTL and similar initiatives have focused on developing core competencies for teaching, mentoring, and professional activities, as well as attempt to shift the disciplinary cultures and attitudes toward education-related practices in these fields (Austin et al., 2009; Vergara et al., 2014). The success of these programs and the unsettling of disciplinary practices, however, have yet to be realized.

To summarize, scholars have drawn attention to what appears to be to a resistance to the adoption of evidence-based, equity-focused educational practices in STEM disciplines. As discussed in Chapter 1, the lack of quality STEM educational experiences has important implications for educational equity, workforce demand, and scientific literacy in the US. Scholars have argued across the literature that instructional change is constrained by disciplinary culture and norms, institutional environments, and availability of teaching development opportunities (Anderson et al., 2011; Brownell & Tanner, 2012; NRC, 2012). Borrego and

Henderson (2014) suggested that the use of multiple instructional change strategies is necessary for addressing these constraints and sustaining reform. As discussed above, college-level instructors have been positioned key actors in instructional change strategies. Scholars have advocated for targeting the teaching development of graduate students, in particular, to shift the future culture and practice in postsecondary STEM education rather than solely focusing on current faculty who may be in environments less conducive to change (Austin et al., 2009; Kezar & Gehrke, 2015). These things considered, the teaching development of STEM graduate students can be conceived of as an important conduit for change.

**Teaching Development for STEM Graduate Students**

Another concern scholars have grappled with has been deciding how to best prepare STEM graduate students to become effective, equity-focused educators. Though designing activities to prepare graduate students as instructors has been a topic of interest for at least 50 years (e.g., Costin, 1968), teaching development efforts specifically for STEM graduate students have only increased in the last 15 years (Connolly et al., 2016). Proponents of discipline-specific or interdisciplinary STEM teaching development have argued for discipline-specific conceptions, cultures, and approaches to teaching (Austin et al, 2009; DeChenne et al., 2012a; Gilmore, Maher, Feldon, & Timmerman, 2015). Whether teaching development should be discipline-specific or transdisciplinary has been widely debated in the literature (Bishop-Williams, Roke, Aspenlieder, & Troop, 2017; Smith & Kanuka, 2018). Some scholars have suggested that transdisciplinary teaching development has been beneficial for making training widely available (e.g., Kanuka, Heller, & Jugdev, 2008). Smith and Kanuka (2018) noted that others have resisted canonical teaching development in favor of approaches that take seriously the value of disciplinary identities, norms, and practices. Nevertheless, disciplinary-focused teaching development has been promoted as a core strategy for postsecondary STEM education reform in the literature in my review.

To support discipline-specific understandings of educational practice, some scholars have suggested the use of a blend of scientific and education-related concepts, such as *teaching-as-research* (Connolly, Bouwma-Gearhart, & Clifford 2007) or *teaching as inquiry* (Miller & Oliver, 2014) that would otherwise be named *action research* (McNiff, 2013) or *scholarship of teaching and learning* in fields of education (Chick & McKinney, 2013). It has been argued that translating education concepts to “STEM friendly” terms that resonate with scientists can be an effective strategy for conceptualizing teaching practice (Connolly et al., 2007, p. 20). These scientized (or STEM-ized) conceptualizations have shaped how some teaching development activities have unfolded. As part of the CIRTL programming, for instance, future STEM faculty participants are required to complete teaching-as-research projects. For these projects, participants identify a learning-related problem or objective, implements or studies a teaching innovation to address the problem, collect and analyze data (e.g., course assignments, tests, midterm feedback), revise teaching practice based on evidence generated in the project, and share the results with peers and colleagues (CIRTL, 2019; Austin et al., 2009). Such attempts to analogize teaching and research practices, thus, have been treated as a way to support graduate student instructors to learn education practices in processes that are similar to their home disciplines.

Table 1

*Types of Teaching Development Activities for Graduate Students*

| Type | Features | Example |
| --- | --- | --- |

| | | |
|---|---|---|
| *Pre-semester orientations* | • Short term (e.g., 1-4 hours in one or more days)<br>• Focused on classroom management, university policies, grading, etc.<br>• Often required | Aaltonen, Foli, Kirby, Simpson, & Walters (2015) |
| *Intensive Workshops and Institutes* | • Multiple days<br>• Focused on developing specific skills (e.g., inquiry-based instruction)<br>• Not typically required | Roehrig, Luft, Kurdziel, & Turner (2004) |
| *Courses* | • Often one term<br>• Structured, instructor-led<br>• Generally includes syllabus<br>• Not typically required | Cherrstrom, Richardson, Fowler, Autenrieth, & Zoran (2017) |
| *Departmental Meetings for Teaching Assistants* | • Regular, throughout the term of instruction<br>• Often focused on preparation for weekly labs or discussion, common question issues, etc.<br>• Typically required | Ishikawa, Potter, & Davis (2001) |

| | | |
|---|---|---|
| *Learning Communities* | ● Long term (at least one term)<br>● Regular meetings (e.g., biweekly)<br>● Often focus on a common project, teaching-related innovation, or topic of interest<br>● Not typically required | Linenberger, Slade, Addis, Elliott, Mynhardt, & Raker, (2014) |
| *Teaching Certificate or Minors* | ● Competency-based training<br>● Institutional recognition<br>● Not typically required | Marbach-Ad, Katz, & Thompson (2015) |
| *Future Faculty Development Programs* | ● Long term (at least one term)<br>● Multiple forms of training (e.g., massive open online courses, learning communities, mentored teaching)<br>● Focused on key skills and competencies of faculty<br>● Not typically required | Prevost, Vergara, Urban-Lurain, & Campa (2018) |

Disciplinary-focused training has taken place in a range of short- and long-term teaching development activities that vary in focus and content (Table 1). Recent studies have shown that short term activities, such as pre-semester instructor orientations, were most commonly available and used at institutions of higher education (e.g., Schussler, Read, Marbach-Ad, Miller, & Ferzli, 2015; Connolly et al., 2016). Longitudinal studies provided evidence that activities lasting at least one term (e.g., 16 weeks) yielded the most gains for teaching self-efficacy and impact on future practice (Connolly et al., 2016; Connolly et al., 2018). As others have observed (e.g., Connolly et al., 2018; Miller, Brickman, & Oliver, 2014), empirical research on the preparation of STEM graduate students for teaching is sparse. Therefore, assessments and comparisons of training are currently limited.

In this section, I have broadly discussed instructional change efforts and forms of teaching professional development to contextualize research conducted on the teaching development of STEM graduate students. Research on this topic is necessarily situated within concerns about how to best prepare STEM graduate students to be responsive to accountabilities to institutional, national, and equity-aligned interests described in Chapter 1. Additionally, this research is situated within ongoing efforts to understand the best strategies for incorporating education training into doctoral education. As discussed below, the study of graduate student teaching development has centered on generating evidence about best practices and common barriers involved in preparing graduate students to implement evidence-based teaching in their current and future roles as educators. I now turn to a discussion of themes across the empirical literature.

**Themes in the Empirical Literature**

Below I describe three themes that I noted across the empirical literature related to STEM graduate student and future faculty teaching development. These themes were (1) varied assessments of teaching development effectiveness, (2) diverse research approaches, and (3) attention to the transmission of culture and norms.

### *Varied Assessments of the Effectiveness of Teaching Development*

Across the literature, studies were focused on answering the question: *how do we know teaching development was effective or impactful?* Researchers used participant-based assessments of various mentalistic constructs (e.g., teaching beliefs) and other-based assessments of practice (e.g., observations) to evaluate graduate student teaching and teaching development activities. In other words, effectiveness, quality, and impact of teaching development were inferred using self-reported psychological states and by using evaluations of observed teaching practice. Assessments were collected using pre- and post-surveys, interviews, observations, institutional data, and were often compared before, during, and after teaching development activities. For participant-based assessments, for example, researchers inferred the effectiveness of teaching development from self-reported, measurable changes in self-efficacy using pre- and post-surveys (e.g., Bauer, Libby, Scharberg, & Reider, 2013). By contrast, other-based assessments, such as observations, were used to determine whether teaching development participants actually implemented research-based teaching while participating in teaching development (e.g., Mutambuki & Schwartz, 2018). Of the 78 studies included in this review, 64 used participant-based and 21 used other-based assessments. While only one study exclusively used other-based assessments (Kendall & Schussler, 2012), 57 relied solely on self-report data for evaluations of the effectiveness, impact, or quality of teaching development.

**Participant's Self-Assessments of Mentalistic Constructs**. Mentalistic constructs were the most commonly named measures of the effectiveness or impact of teaching development activities. Mentalistic constructs refer to terms to describe thought processes or activity (unconscious or conscious, e.g., beliefs) presumed to be in the minds of individuals (Turner, 2012). Researchers in cognitive science and social psychology, for example, have historically attempted to measure, define, identify, or attribute these presumably internal states of individuals as explanations for observable actions and behavior (Potter & Wetherell, 1987; Turner, 2012). Similarly, in science education research, constructs such as *attitudes* (e.g., Roehrig, Luft, Kurdziel, & Turner, 2003) and *teaching beliefs* (e.g., Addy & Blanchard, 2010), have often been used to explain teaching practices or barriers to changing instruction. A total of 28 studies in this review drew upon theory-based mentalistic constructs, while others used general terms (e.g., perceptions) as self-reported assessments of the effectiveness or impact of teaching development.

***Beliefs.*** The most common mentalistic construct used in articles for this review was *teaching beliefs*. The teaching beliefs construct refers to patterns of thoughts and were generally treated as factors or outcomes in interview and survey studies of teaching development activities. In Stephens, Battle, Gormally, and Brickman's (2017) study of feedback in learning communities, the Teaching Beliefs Interview (Luft & Roehrig, 2007) was used to assess shifts in participant beliefs from *traditional* (i.e., teachers as transmitters of knowledge) to *reformed-oriented* (i.e., teachers as mediators of learning). The authors used these theory-based categorizations of beliefs to assess changes in future faculty over time in relation to the quality of feedback given to participants throughout the teaching development program. Similarly, Ebert-May et al. (2015) used the Approaches to Teaching Inventory (Trigwell & Prosser, 2004) to measure teaching beliefs alongside recorded observations of graduate student teaching practice. In both studies, beliefs were measured using research-validated instruments with specific theoretical or conceptual frameworks for defining types of beliefs (e.g. traditional, translational, etc.). A key finding in both studies was that most graduate student instructors shifted toward reform-oriented beliefs by the end of participating in teaching development. In these examples, the authors presumed correlations existed between teaching beliefs, practices (i.e., feedback and teaching), and the effectiveness of teaching development activities. Thus, the term *teaching beliefs* in these studies was conceived of as a theory-defined, measurable factor that could be used to evaluate teaching development and its impact on instructional practice.

***Orientations***. *Teaching orientations* was another construct related to beliefs discussed in only three studies included in this review (Gilmore, 2012; Gilmore et al., 2014; Volkmann & Zgagacz, 2003). Teaching orientations in these studies generally referred to knowledge, beliefs, experiences, instructional decision-making, and perceived purposes for teaching. Compared to the teaching beliefs construct that only considered thought patterns, teaching orientations were generally conceptualized as inclusive of both thought patterns and actions (i.e., instructional acts) as mutually-informative states. This means that beliefs about teaching were assumed to inform practice, while at the same time instructional experience was assumed to inform beliefs about teaching. Volkmann and Zgagacz's (2003), for instance, conducted a phenomenological study of the experience of a physics graduate student (second author) learning to teach. The teaching orientations construct was part of their conceptual framework, along with professional identity, and was used throughout the study to assess Zgagacz's reflections about teaching and instructional practice. In mixed methods studies of graduate student instructors conducted by Gilmore (2012) and Gilmore and et al. (2014), teaching orientations was also used as a conceptual framework. They hypothesized four factors that impact teaching orientations for graduate student instructors: mentoring, education training, teaching experience, and research experience. The authors found that the duration of teaching experience and the quality of mentoring were two key factors that contributed to shifts in teaching orientations. Similarly, Volkmann and Zgagacz (2003) found that their participant's teaching orientations shifted over the course of a semester through guided reflection and was further evidenced by changes in specific instructional practices. Like the studies of teaching beliefs, researchers considered shifts in teaching orientations as evidence that teaching development promoted changes in mental states and actions (i.e., teaching practices).

***Self-Efficacy***. Whereas teaching beliefs and orientations were used as core constructs in many studies of teaching development with STEM graduate students as early as the 1990s (e.g., Johnson, 1998), research using the *self-efficacy* construct has only begun within the last five to 10 years (Connolly et al., 2018; DeChenne, 2010; DeChenne, Koziol, Needham, & Enochs, 2015). The concept of self-efficacy was developed by Albert Bandura (1986). Self-efficacy refers to an individual's confidence to complete a task or action. Bandura theorized four influences of self-efficacy: social persuasion (e.g., feedback), psychological and emotional states (e.g., beliefs), vicarious experiences (e.g., observations), and mastery experiences (e.g., teaching). DeChenne (2010) noted that self-efficacy was not about what a person does, but rather about what they *perceive* they can do given situations or circumstances. Compared to teaching beliefs and orientations, the self-efficacy construct included – explicitly – the context (e.g., disciplinary environment) and social interaction (e.g., with peers, advisors, etc.) as factors that influence the psychological states of individuals. As such, DeChenne (2010) argued for a STEM-specific self-efficacy instrument to account for the ways in which disciplinary contexts potentially shape opportunities for social persuasion, mastery experiences, vicarious experiences, and psychological states.

Six studies included this literature review attempted to correlate participation in teaching development with measures of self-efficacy. In Connolly et al.'s (2018) longitudinal study, for example, survey data was collected from over 2,000 early-career STEM scholars who participated in teaching development during graduate studies. The purpose of their study was to assess correlations between specific training activities and self-efficacy. Similarly, DeChenne et al. (2015) developed a STEM-specific teaching self-efficacy survey instrument to assess correlations between participation in teaching development and teaching self-efficacy. Notably, these studies found positive correlations between self-efficacy and long-term teaching development activities, as well as unchanged self-efficacy for other activities (e.g., short term, informal activities, Connolly et al., 2018). In contrast to these studies of the post-participation impact of teaching development, Bauer et al. (2013) measured self-efficacy using surveys before and after short term teaching workshops. Participants were asked to answer the question, for example, "Has the workshop changed your perspectives about teaching and learning?" to which over 80 percent of participants agreed (p. 41). Additionally, Bauer et al. inferred a positive impact from teaching development activities based on self-assessments of changed perspectives and measured increases in self-efficacy. A measured change in self-efficacy, thus, was used as a proxy for the impact of participation in teaching development.

***Attitudes***. One study included in my literature review referred to changes in attitudes toward teaching as an outcome of teaching development (Roehrig et al., 2003). This study was conducted with chemistry graduate teaching assistants participating in a required, inquiry-focused education training. Training included a four-day orientation workshop, a college teaching seminar, and weekly course meetings. The authors conducted interviews and observations of teaching at various points of the semester to understand the teaching experiences of graduate teaching assistants (GTAs) and their conceptions of teaching as they participated in the training. Key findings were that GTAs' attitudes toward inquiry and understandings of how students learning ultimately shaped instructional decisions. For example, Roehrig et al. (2003) found that GTAs were resistant to using inquiry-based instruction, an evidence-based teaching strategy, and expressed limited views about how students learned best. This study aligned with the beliefs-related studies above in the way it linked psychological processes to teaching practices.

***Perceptions***. Whereas the examples above produced evidence of teaching development effectiveness in terms of thought patterns and instructional practices, three articles included in my review generated evidence of based (in part) on perceived helpfulness or value of programs. Wheeler, Maeng, and Whitworth (2015), for instance, conducted a study of participant perceptions of a teaching assistant training program that the researchers designed and implemented for chemistry undergraduate and graduate teaching assistants. Using surveys and interviews, the authors found that what participants perceived as helpful depended on their background experiences. For teaching assistants who were "rusty" with scientific content, for instance, teaching development components focused on disciplinary knowledge were perceived as most helpful (Wheeler et al., 2015, p. 834). In another study, Marbach-Ad, Ziemer, Orgler, and Thompson (2012) used interviews to assess chemistry graduate student perceptions (used interchangeably with the term *attitudes*) about their experiences in an education course. The authors reported that graduate students characterized the value of their participation in the course as enjoyable, positive, and interesting, for example. The authors in both studies suggested that investigations of the perceptions of teaching development could be useful for informing training design. Further, Wheeler et al. (2015) recommended that future studies should assess the relationship between teaching development, instructional practice, and perceptions of training. In these studies, then, graduate student perceptions of teaching development experiences were considered a measure of the usefulness of teaching development.

To summarize, self-report data were most commonly used to generate evidence about the effectiveness and impact of teaching development. This is consistent with researchers' comments about the extensive use of self-report data in STEM teaching development research (Connolly et al., 2018; NRC, 2012). Of note, several studies in this review used the terms *attitudes*, *beliefs*, perceptions, and related concepts interchangeably or in a general sense (e.g., Barger & Webb, 2006; Belnap, 2005; Dillenburg & Connolly, 2005). This usage was in contrast to the construct- or theory-based conceptualizations of the beliefs-related terms discussed above (e.g., teaching orientations). An exemplar of this was Barger and Webb's (2006) evaluation study of graduate student and postdoctoral scholars' participation in teaching development activities. The authors stated that the purpose of their study was to understand the perceptions of participants in teaching development activities. The research questions were both framed in terms of attitudes and beliefs, and, thus, positioned these constructs as proxies for assessing perceptions. Attitudes and beliefs were not explicitly defined. However, attitudes and beliefs were measured based on the participants' Likert-scale ratings of prompts about their *teaching conceptions*. Without belaboring the point, this study evoked at least four mentalistic constructs (i.e., *perceptions*, *beliefs*, *attitude*, *and conceptions*) in interchangeable, undefined ways. This perhaps represents a potential lack of clarity in constructs and concepts in the literature.

Nevertheless, common across studies that used belief-related constructs were explicit connections between psychological states, teaching practices, and teaching development. The implication of making these connections is that the effectiveness of teaching development and the promise of instructional change were positioned as hinged on whether beliefs, orientations, self-efficacy and the like can change as a result of participation in teaching development.

**Other-Based Assessments**. About a quarter of the studies included in this review used assessments of teaching development that were not self-reported from the participants themselves. These included observations of teaching practice, undergraduate student evaluations of teaching, and institutional data from students in courses taught by graduate students (e.g., semester grades). With one exception (Kendall & Schussler, 2012), other-based assessments were used in combination with participant-based assessments.

***Observations.*** A total of 16 studies used observations to assess the effectiveness or impact of teaching development activities. Of these, half of the studies used video-recorded observations. Observations were conducted either by peers, teaching development program facilitators, or researchers. In Luft, Kurdziel, Roehrig, and Turner's (2004) study, graduate teaching assistants who participated in teaching were randomly selected for observation. As participant observers, researchers produced written observations that attended to student placement, dialogue, activities, and instructor behaviors. Several studies used the Reformed Teaching Observation Protocol (Sawada et al., 2000) as a rubric for assessing the extent to which graduate student instructors used student-centered instruction, particularly for studies that used video recordings (Addy & Blanchard, 2010; Ebert-May et al., 2015; Wyse, Long, & Ebert-May, 2014). In Wyse et al.'s (2014) study, for instance, video recordings of teaching were analyzed by researchers and correlated with teaching development activities of varying levels of engagement. Similarly, in Addy and Blanchard's (2010) study with life science GTAs in a teaching certificate program, researchers coded videos of classroom teaching to assess relationships between beliefs (e.g. reform-oriented), instruction (e.g., student-centered teaching), and education training. Observations were used in combination with self-report data to corroborate claims about the effectiveness of teaching development and potential shortcomings in teaching practice.

Notably, studies that used observations sometimes reported varied relationships between self-reported states (e.g., teaching beliefs) and observed practices. In Addy and Blanchard's (2010) study, observed instruction practices were scored similarly for participants with either reform-oriented beliefs or teacher-centered beliefs. This means that reform-oriented beliefs did not necessarily translate to reformed teaching practices. In another observational study by Mutambuki and Schwartz (2018), teaching practices (e.g., questioning techniques, communicating goals) learned during professional development were variably implemented by chemistry and biology GTAs. The researchers observed that only 43 percent of targeted teaching practices were implemented in the classrooms that trained graduate teaching assistants taught. Findings from these studies pointed to gaps between what teaching development participants believed (Addy & Blanchard, 2010) or learned (Mutambuki & Schwartz, 2018) about teaching and their observed teaching practices. The authors explained these gaps in terms of the limited control GTAs had for designing curriculum and course structure, or because of the difficulty with implementing evidence-based teaching. Nevertheless, observations were used in studies to assess the impact of teaching development on actual teaching practices.

***Undergraduate Student Data***. Two forms of undergraduate student data were used in five studies as other-based assessments of graduate student teaching and teaching development: surveys and course grades. Researchers were broadly interested in undergraduate student perceptions of the quality of graduate student teaching, as well as student performance in courses taught by trained and untrained graduate student instructors. Kendall and Schussler (2012) used two surveys, the College and University Classroom Environment Inventory (Treagust & Fraser, 1986) the Questionnaire of Teacher Interaction (Coll, Taylor, & Fisher, 2002), to compare undergraduate student perceptions of professors and graduate student instruction. They found that undergraduates generally perceived professors to be more organized and knowledgeable compared to relaxed, unsure GTAs. In another example, Hughes and Ellefson (2013) conducted a semi-controlled randomized trial to compare teaching effectiveness of graduate student instructors who participated in teaching development for inquiry-based pedagogy or generalized best practices instructional training (control group). They administered a modified version of Student Evaluation of Educational Quality (Marsh, 1982) and the Cognitive Learning Evaluation surveys for undergraduate students to rate the quality of graduate student teaching and their learning experiences. Additionally, Hughes and Ellefson used undergraduate student grades as a key factor for determining teaching effectiveness. They found that GTAs in the inquiry-pedagogy group received higher survey scores and their students earned better grades compared to the control graduate teaching assistants group. Undergraduate student data (i.e., surveys and course grades) in these studies were considered factors for external assessments of the impact of teaching development on graduate student instruction.

Other-based assessments of graduate student instruction were used as corroborative evidence about the perceived quality of graduate student teaching practice and the effectiveness of teaching development. As discussed above, studies that used both self and other-based assessments sometimes made visible differences between beliefs, for instance, and practice. Wyse et al. (2014) argued that self-report data on their own did not reflect what graduate student instructors knew about instructional strategies, nor did they predict the practices implemented in their classrooms. Yet, self-report data were most commonly used in studies included in this review, as well as in the broader literature about STEM teaching development and instructional change (Connolly et al., 2018; Henderson et al., 2011; NRC, 2012). In another vein, only a handful of studies included in this review investigated the actual practices of *doing* teaching development (e.g., Stephens et al., 2017; Mutambuki & Schwartz, 2018). Thus, the current research has produced knowledge mostly about what STEM graduate student instructors think about teaching or how they well (or not) they use evidence-based teaching practices but provided few insights about what actually happens during teaching development to promote changes in beliefs or practice.

***Diverse Research Approaches***

The approaches to research on STEM graduate student teaching development varied widely. Evaluation research was the most commonly named approach comprising 33 of the 78 studies, followed by 19 mixed methods, 15 qualitative research or methods, and 11 quantitative studies. I did not locate any discourse analysis or conversation analysis studies of STEM graduate student teaching development, though a few studies examined discourse and interactions. The types of studies conducted will be discussed in detail below.

No common theoretical or philosophical perspectives were evident across the literature. Few studies described specific psychological, sociological, or learning-related theoretical frameworks or philosophical perspectives that informed the research being carried out. This is consistent with concerns that empirical studies of STEM graduate student teaching development have infrequently included established theories and concepts that are commonly used in education research (NRC, 2012; Wheeler et al., 2015). Example exceptions cited the following theoretical frameworks: Baxter Magolda's Epistemological Reflection Model (e.g., Sandi-Urena, Cooper, & Gatlin, 2011), community of practice (e.g., Chen et al., 2017), situated learning theory (e.g., Dotger, 2011), social cognitive career theory (e.g., Connolly et al., 2018), sociocultural constructivist theory (e.g., Buck, Leslie-Pelecky, Lu, Plano Clark, & Creswell, 2006), and socialization theory (e.g., Feldon, Maher, Roksa, & Peugh, 2016).

The contexts of research also varied. Most studies were conducted in interdisciplinary STEM settings compared to discipline-specific contexts (e.g., chemistry). The studies in interdisciplinary STEM settings generally focused on the experiences of graduate students in teaching development activities, such as mentored learning communities (e.g., Baiduc Linsenmeier, & Ruggeri, 2016), future faculty development programs (e.g., Vergara et al., 2014), and teaching interventions (e.g., Cherrstrom, Richardson, Fowler, Autenrieth, & Zoran, 2017). Comparatively, discipline-specific studies involved investigations of particular groups of graduate student instructors (e.g., biology graduate teaching assistants) or teaching development interventions to improve discipline-specific forms of education (e.g., chemistry laboratory instruction). In Goodwin et al.'s (2018) study, for instance, biology graduate students were interviewed about their experiences learning about and implementing evidence-based teaching. While the researchers were not investigating discipline-specific teaching practices, they were focused on understanding the experiences of biology students in general. By contrast, Wheeler et al. (2015) conducted a study of the experiences of chemistry student instructors learning to use inquiry-based teaching to improve instruction in chemistry laboratory courses. Both discipline-based education research and interdisciplinary STEM education studies considered the unique, context-related factors that shaped the experiences and practices of graduate student instructors.

Table 2

*Distribution of Disciplinary Focus of Literature Reviewed*

| Discipline | n | Example |
|---|---|---|
| STEM or Interdisciplinary | 36 | Baiduc, R. R., Linsenmeier, R. A., & Ruggeri, N. (2016). Mentored discussions of teaching: an |

| | | |
|---|---|---|
| | | introductory teaching development program for future STEM faculty. *Innovative Higher Education*, *41*(3), 237-254. |
| Biology | 15 | Wyse, S. A., Long, T. M., & Ebert-May, D. (2014). Teaching assistant professional development in biology: designed for and driven by multidimensional data. CBE-Life Sciences Education, 13(2), 212-223. |
| Chemistry | 10 | Herrington, D. G., and Nakhleh, M. B. (2003). What defines effective chemistry laboratory instruction? Teaching assistant and student perspectives. *Journal of Chemistry Education, 80*, 1197-1205. |
| Mathematics or Statistics | 7 | Justice, N. (2017). *Statistics graduate students' professional development for teaching: A communities of practice model* (Unpublished doctoral dissertation). University of Minnesota, Minneapolis, MN, USA. |
| Engineering | 5 | Torres Ayala, A. T. (2012). *Future engineering professors' conceptions of learning and teaching engineering* (Unpublished doctoral dissertation). University of South Florida, Tampa, FL, USA. |

| | | |
|---|---|---|
| Physics | 2 | Volkmann, M. J., & Zgagacz, M. (2004). Learning to Teach Physics through Inquiry: The lived experience of a graduate teaching assistant. *Journal of Research in Science Teaching, 41*(6), 584–602. |
| Biomedical and health-related fields | 2 | Lederer, A. M., Sherwood-Laughlin, C. M., Kearns, K. D., & O'Loughlin, V. D. (2016). Development and evaluation of a doctoral-level public health pedagogy course for graduate student instructors. *College Teaching, 64*, 19–27. |
| Earth science | 1 | Dotger, S. (2011). Exploring and developing graduate teaching assistants' pedagogies via lesson study. *Teaching in Higher Education, 16(*2), 157–169. |

The articles in this review were published in 26 different journals and included seven disciplinary foci (Table 2). Discipline-based education research was often published in field-specific journals, such as *CBE-Life Sciences Education* (e.g., Goodwin et al., 2018; Schussler et al., 2015) and *Chemistry Education Research and Practice* (e.g., Sandi-Urena, Cooper, & Gatlin, 2011; Wheeler et al., 2015). Comparatively, interdisciplinary STEM studies were published in journals for varied audiences, such as higher education (e.g., *Innovations in Higher Education,* Baiduc et al., 2016*),* general science education *(*e.g., *Journal of the Scholarship of Teaching and Learning*, Buck et al., 2006*),* and the sciences (e.g., *Science,* Pfund et al., 2009). The *Journal of*

*College Science Teaching*, a practitioner-focused journal, had the highest number of articles (nine), including either interdisciplinary STEM or discipline-specific studies.

**Evaluation Research**. Program evaluation was the most common purpose for research cited in the literature. Research in this approach most often used pre- and post-surveys and interviews to assess the effectiveness of teaching development activities. Chen et al., (2017) conducted an evaluation study of a teaching development program for future faculty in medical sciences (e.g., medical doctors, nurse practitioners). The purpose of the program was to support the professional identity development of medical practitioners to be inclusive of the role of educator. To evaluate the program, the authors assessed program completion rates and administered a post-participation survey. The survey prompted participants to rate their satisfaction with the program. In a similar study, Vergara et al. (2014) described and evaluated the Future Academic Scholars in Teaching (FAST) Fellowship Program, a future faculty development program for STEM doctoral students. The objective of this evaluation study was to assess the knowledge, experiences, satisfaction, and career interests of participants in the FAST program. Data sources include interviews and surveys completed at both the beginning of the program and six months after finishing. These were two exemplars of the type of evaluation studies included in this review.

Participants in evaluation studies typically reported overwhelmingly positive satisfaction (e.g. 92 percent satisfaction, Vergara et al., 2014) or usefulness (e.g., 71.1 percent useful, Baiduc et al., 2016) ratings for teaching development activities. Evaluations of satisfaction were often reported in terms of perceived usefulness, helpfulness, or benefits of participating in teaching development. A couple of reasons reported for dissatisfaction or lack of usefulness of teaching development were related to participants' difficulty with understanding how to teach for diversity in the classroom (e.g., Baiduc et al., 2016) and due to time constraints that created obstacles for completing programs (e.g., Chen et al., 2017). Reports of dissatisfaction or low effectiveness, however, were rare.

Findings from evaluation studies also reported learning gains based on pre- and post-survey differences. Linneberger et al. (2014) administered surveys at the beginning, middle, and end of a year-long, interdisciplinary STEM graduate student learning community focused on developing skills to facilitate course-based research experiences. The results from pre-surveys were compared to one semester and two-semester time points to assess knowledge gains. The authors reported learning gains from at least one semester to the next for all topics discussed, such as knowledge about learning assessments and Bloom's taxonomy. In a similar study, Lederer et al. (2016) administered pre-, mid-, and post-participation survey of knowledge about pedagogy concepts to assess the learning gains in a semester-long pedagogy course for public health graduate students. They reported learning in both general and discipline-specific pedagogy concepts. Significant gains were reported for awareness of campus resources to support students, knowledge of learning assessments, and comfort using multiple teaching strategies. Non-significant gains were reported for developing course syllabi, creating learning objectives, and self-assessments of teaching effectiveness.

In general, evaluation studies generated evidence about learning gains or participant satisfaction after completing teaching development activities. Theoretical, philosophical, or conceptual frameworks or models were largely absent in evaluation studies. Two studies of the 33 studies included frameworks or models: one used community of practice and professional identity (Chen et al., 2017); and the other used self-efficacy (Bauer et al., 2013). Evaluation studies in this review conveyed a causal orientation to research on STEM graduate student teaching development. Meaning, research suggested that if graduate students participate in teaching training, then they were more likely to report gains in knowledge about teaching or report that the activities were useful as a result of participation. This causal orientation is complicated by studies that have demonstrated the limited or lack of translation of reported knowledge or beliefs to the implementation of practice (e.g., Goodwin et al., 2018; Wyse et al., 2014). Nevertheless, evaluation studies provided important information about participants' assessments of these activities that can be useful for improving program designs.

**Mixed Methods Research**. Studies that named mixed methods as the research design referred to using a combination of qualitative and quantitative methods for data collection and analysis. Of the 78 studies, 19 were named mixed methods. Connolly et al. (2016, 2018) reported findings from the first longitudinal study of STEM graduate student teaching development that took place between 2008 and 2013. They collected survey data from over 3,000 doctoral students at research-intensive institutions and conducted interviews with a subset of the larger group (n=75). The goal of these studies was to analyze the impact of teaching preparation during graduate studies on later practice. Most of the mixed methods studies took the form of self- and other-based assessments of teaching development described above (e.g., Addy & Blanchard, 2010; Gilmore et al., 2015; Wyse et al., 2014). Research of this sort included quantitative analysis of surveys and qualitative analyses of observations and interviews, for example, for triangulation of evidence about the effectiveness of teaching development activities.

Compared to evaluation research, most of the mixed methods studies named a philosophical, theoretical, or conceptual framework or model that informed their research. All but one of the 19 studies named a model or framework, including community of practice (e.g., Gallagher, 2016), phenomenology (Gallagher, 2016), self-efficacy (e.g., Gaskins, 2014), socialization (e.g., Feldon Maher, Roksa, & Peugh, 2016), social cognitive career theory (e.g., Connolly et al., 2018), social constructivism (e.g., Wyse et al., 2014), teaching beliefs (e.g., Ebert-May et al., 2015), and teaching orientations (e.g., Gilmore et al., 2014). An article by Feldon et al. (2011) published in the journal *Science* was the only mixed study that did not name a specific framework or model. One could speculate that this may be due to the audience or journal restrictions for *Science* as Feldon and colleagues have included frameworks, such as teaching orientations (e.g., Gilmore et al., 2015) and socialization (e.g., Feldon et al., 2016) elsewhere.

An exception aside, mixed methods research included philosophical, theoretical, and conceptual resources to frame studies and/or analyze both quantitative and qualitative data sources. Some researchers emphasized the importance of self- and other-based assessments, such as observations and interviews, to deal with the limitations of self-reported data alone to evaluate the impact of teaching development efforts (e.g., Feldon et al., 2106; Wyse et al., 2014). Others advocated for the use of multiple forms of self-reported data (e.g., interviews and surveys) for triangulation and to increase the validity of findings (e.g., Gaskins, 2014; O'Neill & McNamara, 2016; Trouba, 2009). In both cases, mixed methods research was positioned as a more reliable or accurate approach for the study of teaching development than, say, quantitative surveys or qualitative interviews on their own. Despite this positioning, mixed methods helpfully drew attention to potential dilemmas and gaps between teaching beliefs (and other constructs) and practice.

**Qualitative Research or Methods**. The use of qualitative research or methods studies in this review was quite diverse. The most common qualitative research *methods* used were interviews. Interviews were used in 34 studies, compared to 16 with observations and eight studies using focus groups. In contrast to evaluation and mixed methods research that often had similarly designed studies (e.g., pre- and post-surveys), each of the qualitative studies was unique in their design, analytic approach, data sources, and research perspectives. Fifteen studies named a qualitative *research* approach (compared to only using qualitative *methods*) and drew upon situated learning theory (e.g., Dotger, 2011; Wheeler et al., 2015), constructivist inquiry (Luft et al., 2004), Rogers' diffusion of innovation model (Goodwin et al., 2018), sociocultural constructivist theory (Buck et al., 2006), and identity-related constructs (Sandi-Urena & Gatlin, 2013; Volkmann & Zgagacz, 2004) in addition to some of the philosophical, theoretical, or conceptual frameworks or models named in the evaluation and mixed methods studies above.

Despite the diversity across the qualitative studies, researchers discussed a shared goal of understanding the experiences and meaning-making of STEM graduate student participants in teaching development activities. In a study by Goodwin et al. (2018), interviews were conducted with 32 biology graduate teaching assistants to understand their experiences with learning about and implementing evidence-based teaching practices. The authors used Rogers' (2003) Diffusion of Innovations Model as a framework for coding interview responses along the five stages of the adoption of evidence-based teaching (i.e., the innovation): *knowledge*, *persuasion*, *decision*, *implementation*, and *confirmation*. The authors found that while at least 75 percent of interviews were aware of (*knowledge*) and in favor of (*persuasion*) evidence-based teaching, only 37.5 percent of them actually implemented these practices. Another qualitative study by Sandi-Urena and Gatlin (2013) sought to compare the meaning-making and experiences of chemistry graduate student instructors in expository (i.e., tradition, verification-based learning) versus inquiry-based (i.e., open-ended, reform-oriented) instructional contexts. Specifically, the authors discussed the goal of identifying key factors that contributed to graduate teaching assistants' self-image as instructors, as well as how their roles were constructed in differing instructional environments. Using semi-structured interviews, they found that self-image was shaped by five factors: (1) background experiences, (2) training, (3) epistemological beliefs (e.g., nature of science), (4) beliefs about academic laboratory work, and (5) the involvement graduate teaching assistants in laboratory settings.

The authors of both studies drew attention to institutional contexts as key obstacles for STEM graduate students learning how to teach. Goodwin et al. (2018), for instance, reported that over 70 percent of interviewees cited a lack of institutional support as a key barrier to the implementation of evidence-based teaching. Likewise, Sandi-Urena and Gatlin (2013) found significant differences in self-image based on instructional context, which they argued impacts instructional decisions and, therefore, teaching effectiveness. Other qualitative studies reported that the culture of science (e.g., Buck et al., 2006), teaching beliefs (e.g., Mutambuki & Schwartz, 2018), attitudes toward teaching (e.g., Roehrig et al., 2003), and unstructured socialization (e.g., Mena, 2010; Saddler, 2000) were barriers to the effectiveness of teaching development efforts.

The qualitative studies in this literature review were focused on meaning-making practices and experiences of STEM graduate students learning how to teach. This contrasted with mixed methods and evaluation research that were primarily focused on evaluating the effectiveness of teaching development for changing beliefs or practices. Additionally, qualitative studies often made visible barriers in the adoption of evidence-based teaching and identities from the perspective of participants. Qualitative studies included in this literature review provided key insights into the lived experiences of participants' in STEM graduate student teaching development activities.

**Quantitative Research.** The remaining 11 studies included in this literature review named their research approach as quantitative, four of which were conducted by DeChenne et al. (2010, 2012a, 2012b, 2015). Most of these studies were survey research or correlational studies (e.g., DeChenne et al, 2015; BrckaLorenz, 2008). Additional research approaches reported were a semi-randomized control trial (Hughes & Ellefson, 2013), causal-comparative and correlational design (Johnson, 1998), longitudinal research (Childs, 2006). Researchers engaged variably with theory and research-derived concepts. Dechenne et al. (2015), for instance, based their survey design on Bandura's (1986) conceptualization of self-efficacy. Justice (2017) used Lave and Wenger's (1991) model of community of practice frame the study and designed survey items to measure beliefs and orientations, for example. The general aim of quantitative studies was to make correlational or causal claims about the socialization or preparation of STEM graduate students for teaching.

Informed by socialization theory, BrckaLorenz (2008) administered an adapted version of the College Teaching Behaviors Instrument created by Braxton and Bayer (1999) to graduate students and faculty to compare attitudes and beliefs toward teaching in different disciplines. The author found key differences across disciplines, as well as between faculty and graduate students. In "hard academic disciplines" (e.g., physics), for instance, students and faculty reported negative views about teaching compared to those in "soft academic disciplines" (e.g., education) (p.10). This was the only study in my review that compared STEM and non-STEM graduate students and faculty. Other quantitative studies assessed correlations between participation in STEM graduate student teaching development activities and teaching self-efficacy (e.g., DeChenne et al, 2015), quality of teaching from the perspective of undergraduates (e.g., Hughes

& Ellefson, 2013), or teaching effectiveness based on undergraduate student performance (e.g., Johnson, 1998).

Like qualitative studies, the design and perspectives drawn upon in quantitative studies were diverse. These studies often included surveys with a large number of participants (e.g., N=1,049, BrckaLorenza, 2008) to make generalizable claims about STEM graduate education. Some researchers cited unique contextual factors, such as local graduate teaching assistant teaching development practices (Kendall & Schussler, 2012) and departmental environment (Childs, 2006), as well as small sample sizes (DeChenne, 2010) and non-random sampling (Justice, 2017) as limitations to the generalizability of study results. These limitations considered, quantitative studies of STEM graduate student teaching development were designed to assess trends that might be applicable to graduate students in various settings.

**Studies Related to Analyses of Discourse or Interaction.** I was unable to find studies that named discourse analysis or conversation analysis as a research approach. However, two mixed methods studies in this review explicitly discussed giving attention to discourse or feedback (Miller, Brickman, & Oliver, 2014; Stephens et al., 2017). In the study by Miller et al. (2014), the reflective discourse was conceived of as an important aspect of teaching development for biology undergraduate and graduate student teaching assistants. The purpose of this study was to describe the implementation of a peer and teaching observational protocols designed for undergraduate and graduate students inquiry-based biology labs. The teaching assistants in the study used these protocols to conduct peer observations of teaching and participated in post-observation reflective discourse. While the authors did not analyze or record the reflective discourse sessions, they did report that most participants found these sessions beneficial.

Stephens et al. (2017) studied the feedback given in a graduate student learning community alongside an analysis of the teaching beliefs of participants. Verbal and written feedback was given to future faculty about their facilitation of active learning activities. The verbal feedback was recorded, transcribed, and given to future faculty participants. The authors coded feedback statements for both the types of feedback (i.e., supportive, critical, directive, or nondirective) and for the cognitive behaviors the feedback suggested (i.e., interactive, constructive, active, and passive). A key finding was that peers and faculty gave the same types of feedback. Specifically, no significant differences between peers and faculty were found for the proportions of types of feedback and the behaviors suggested. However, the authors found that over 60 percent of future faculty preferred critical feedback to come from faculty rather than peers. They also reported no preference for verbal versus written feedback. This study is one of a few studies in my review of the literature that analyzed the actual practices of doing teaching development.

While most of the other studies included in this review relied on talk for data sources (e.g., interviews), these were the only two studies that gave explicit attention to discourse or interactions. The Stephens et al. (2017) study, in particular, highlighted the ways in which forms of feedback shaped how participants received or acted on comments about their teaching. Both studies provided insights into the importance of feedback for STEM graduate students learning how to teach.

***Attention to Culture, Identities, and Socialization Related to Teaching***

The final theme in my review of the literature was studies of culture, norms, socialization, and identities related to teaching in STEM disciplines. Though these studies were largely about learning to teach within particular contexts and discipline-specific norms and culture, very few articles actually studied norms, cultures, socialization practices, and identity-related concerns. An example of this was how socialization theory was used as a theoretical or analytical framework (e.g., BckaLorenz, 2008; Feldon et al., 2016) contrasted with studies that sought to study socialization itself (Mena, 2010; Saddler, 2008). This was surprising given culture and socialization in STEM were often cited in the literature as key barriers to whether future faculty were prepared for teaching (e.g., Austin et al., 2009), whether environments supported evidence-based teaching (e.g., Anderson et al., 2011; NRC, 2012), or if professional identities were inclusive of teaching (e.g., Brownell & Tanner, 2012). Below I discuss two sub-themes, socialization and identity, characterizing the studies that included considerations of social and cultural processes involved in teaching development.

**Socialization**. As noted above, socialization was either used as a theoretical framework or a topic of study. Two studies were qualitative and the others were quantitative and mixed methods; three of these studies were dissertations. The authors of these studies sought to describe graduate student experiences or explain data in terms of socialization processes.

The purpose of Mena's (2010) dissertation study was to examine the impact of teaching on the socialization of engineering doctoral students. The author conducted a qualitative, phenomenological study and drew upon situated learning theory as a theoretical framework. A key finding in this study was that engineering graduate teaching assistants were able to translate teaching-related skills into other career-related professional practices, such as preparing presentations, time management, and communication. Similarly, Saddler's (2008) dissertation examined the socialization of graduate students in engineering preparing for future roles as faculty. Both studies reported that engineering doctoral students perceived interactions with peers, mentors, and faculty as important aspects of their socialization. It is important to note that the role of interactions with others - both formal and informal – has been identified as a core component of socialization theory used in literature about graduate student socialization more generally (e.g., Austin & McDaniels, 2006; Weidman, Twale, & Stein, 2001). These studies further affirmed the importance of interactions for engineering doctoral students. Though not the goal of either study, actual (compared to self-reported) interactions were not examined and, thus, provided only individualized accounts of the perceived influences of peers, mentors, and faculty for socialization.

The two remaining studies drew upon socialization theory as a theoretical framework to analyze and explain data. As discussed in earlier sections, BrckaLorenz's (2008) dissertation study used socialization theory to design a survey instrument for graduate students in STEM and non-STEM disciplines. In Feldon et al.'s (2016) sequential exploratory mixed methods study, a combination of qualitative interviews and quantitative performance data were used to analyze differentiating trends among participants' perceptions of socialization and their performance. Interviews were conducted to assess graduate student perceptions of theory-based aspects of socialization, including relationships with advisors, participation in academic activities, and research identity. The quantitative instrument was a scientific reasoning test administered at the beginning and end of an academic year. Additionally, the authors collected and coded graduate student research proposals to assess skills development as a proxy for socialization. A key finding in this study was a measurable gap between low performing and high performing in scores on scientific reasoning tests and research proposals. The authors also found that this gap widened over the course of an academic year. They argued that these gaps were potentially due to differences in socialization experiences among graduate students, particularly as a result of positive or negative interactions with advisors. Though this study was not directly focused on teaching development, Feldon and colleagues have argued elsewhere that teaching development is positively correlated with improvements in research skills (Feldon et al, 2011; Gilmore et al, 2014). As such, this study provided a broader view of STEM graduate student socialization and its potential impact on those learning how to teach.

**Identity and Self-Image.** Although scholars have agreed that identity is an important part of socialization for academic roles (e.g., Austin, 2010; Luft et al., 2004) and argued that identity as something that can be fostered through teaching development (e.g. Bauer et al., 2013; Volkmann & Zgagcz, 2004), only five studies in this review were focused primarily on identity and identity development. Of these, three studies combined conceptions of professional identity with Lave and Wenger's (1991) model of community of practice (Buck et al., 2006; Chen et al., 2017; Gallagher, 2016), one combined teaching orientations and identity (Volkmann & Zgagacz, 2004), and the other study by Sandi-Urena and Gatlin (2013) used the construct, *self-image*, that they developed based on their prior empirical studies. Common across the studies were social, rather than individualized, conceptions of identity.

Buck et al. (2006) conducted a qualitative study with eight women graduate students involved in a focused NSF fellowship program designed to support collaboration between scientists and K-12 educators for teaching. The authors argued that a combination of gendered- and discipline-specific socialization practices shaped the experiences and professional identities of graduate women in the program. Through analysis of interviews, focus groups, and program artifacts, the authors found that participants' self-definition as scientists were inclusive of other aspects of their lives (e.g., motherhood, relationships) that sometimes did not align with masculine, stereotypical views of scientists. The authors argued that the education program provided these women opportunities to participate in activities that aligned with and affirmed their values (e.g., caring, relationships) that were oftentimes discouraged in a disciplinary setting. This article was one of two included in the literature review that considered the way in which social positions and identities (e.g., ability, gender, race, etc.) might shape how graduate students in STEM fields experience teaching development (see Connolly et al., 2018, for another example).

In contrast to this study, Gallagher's (2016) mixed methods dissertation combined Ronfeldt and Grossman's (2008) framework for professional identity and Lave and Wenger's (1991) model of community of practice to understand the experiences of mathematics graduate students teaching for the first time. The author argued that these perspectives would be helpful to understand how participants make sense of professional learning and the context-specific influences on identities. Based on surveys, interviews, and program artifacts for four research participants, the author found that most math graduate students received negative views from faculty and mixed messages from peers about teaching. The author also found that participants reported interactions, especially with peers, as central in shaping professional identity more so than content knowledge and teaching experience. Though the articles by Buck et al. (2006) and Gallagher (2016) focused on different groups and settings, both studies provided evidence that graduate students learned which academic activities were valued (or not) within their STEM departments.

The final identity-related study compared the experiences of graduate teaching assistants who were teaching in traditional and reform-focused instructional contexts (Sandi-Urena & Gatlin, 2013). This study was discussed in the sections above, so below I focused on the conceptualization of self-image in this section. Compared to the other identity-related studies, the authors developed the concept of self-image based on their empirical studies (e.g., Sandi-Urena et al., 2011), Baxter Magolda's (2004) Epistemological Reflection Model, and literature related to STEM graduate student teaching development (e.g., Roehrig et al., 2003). The authors introduced three propositions that guided their research and conceptualization of self-image (p. 1305):

> Proposition 1: Graduate teaching assistants' teaching performance is associated with the way they see themselves as instructors, that is their graduate teaching assistants' self-image.
> Proposition 2: In the absence of any other factor, graduate teaching assistants will base the construction of their graduate teaching assistants' self-image on their perception and interpretation of prior experiences.
> Proposition 3: Training and staff meetings influence graduate teaching assistants' construction of their self-image.

Based on these propositions, Sandi-Urena and Gatlin (2013) conducted a qualitative study of graduate teaching assistants in differing contexts to compare constructions of self-image across settings. The authors argued that self-image was recursively constructed by graduate teaching assistants in complex, mutually-informing ways. Compared to other studies of identity, these authors developed a unique conceptualization of identity

The studies in this section sought to examine how culture, socialization activities, and identity shaped how STEM graduate students experienced teaching and teaching development. As noted above, the social and cultural processes involved in teaching development have been understudied. These studies provided insights into how messaging and disciplinary environments may shape how STEM graduate students experience teaching and their perceived roles as instructors.

**Discussion of the Empirical Literature on STEM Graduate Student Teaching Development**

The study of STEM graduate student teaching and teaching development has been a growing area of inquiry. In this section, I draw attention to some of the key strengths, weaknesses, and gaps in the literature base. The strengths and weaknesses of this literature were related to multi-disciplinary engagement, methodological diversity, and efforts to link research, practice, and problems. It is not my goal to make claims that privilege one research approach over another, but rather I hope to draw attention to how particular research approaches were used to produce different knowledge about aspects related to STEM graduate student teaching development. In other words, I am in favor of a multi-perspectives approach to solving problems without advocating for the need to mix or combine methods to overcome the shortcomings of particular research approaches. This commitment comes with the recognition that different research approaches will inevitably produce varied and sometimes conflicting findings. As such, the strengths and weaknesses discussed below should be read as framed by a commitment to pluralism (Moss et al., 2009). The two strengths I will discuss below are (1) multi-disciplinary engagement for the research of STEM graduate student teaching development, and (2) diversity of methodological approaches to research on this topic. Three weaknesses of the literature base were that (1) scholarly discussions of STEM graduate student teaching development occurred in siloes with limited cross-disciplinary dialogue, (2) research studies were highly individualized and included limited theoretical grounding, and (3) a gap between the known barriers to instructional change and what has been studied. I also discuss some of the general limitations that have connections to the methodological approach I propose.

The first strength of the literature base was that many disciplines have been involved in researching STEM graduate student teaching development. The studies included in my review cut across many disciplines, including fields of science (listed in Table 2) and fields of education, such as higher education, general science education, faculty development, and discipline-specific education (e.g., chemistry education). Such multi-disciplinary engagement means that studies of STEM graduate student teaching have reached many audiences and potentially broadened the impact of evidence for instructional change. In their literature review, Henderson et al. (2011) noted that STEM teaching development research has taken place in three distinct research communities: higher education research, discipline-based education research (including science education), and faculty development research. Notably, they found very little cross-community dialogue, which was the case in the literature for this review. Researchers who drew upon the same constructs (e.g., self-efficacy), for instance, were rarely cross-cited. I consider this a key weakness of the literature base, particularly for researchers who are interested in developing cumulative lines of inquiry and findings. However, discipline-specific research communities provided opportunities for researchers and practitioners within these fields to address the unique concerns, norms, cultures, and practices among community members. This multidisciplinary engagement was a strength for the literature because of discipline-specific engagement, yet weakened by limited cross-community dialogue and siloed scholarship.

Another strength of the literature was the diversity of methodological approaches. Each research perspective contributed valuable knowledge about challenges and successes in studies of STEM graduate student teaching and teaching development. Qualitative studies provided key insights into the unique experiences in STEM graduate student socialization, whereas quantitative studies identified important trends that might apply all students. Mixed methods studies were valuable for making visible potential gaps between teaching beliefs (or other constructs) and practice that would have otherwise been missed in qualitative or quantitative studies alone. Qualitative, quantitative, and mixed methods studies represented the minority of research on this topic. The literature base was majority evaluation research, comprising 70 percent of studies. Evaluation studies focused on graduate students' perceived value of teaching development activities, most often for individual or institution-specific programs. The strength of evaluation studies in this review was that it provided feedback that institutional leaders could use to improve teaching development designs and offerings. The studies in this review, however, were often highly individualized, based on satisfaction ratings, and limited in their engagement with established theories and concepts commonly used in education research. In fairness, Borrego and Henderson (2014) argued that education research has often been inaccessible to those in non-education disciplines looking to change educational practices. Thus, it was unsurprising that scholars who conducted educational research outside their home disciplines might be unfamiliar with theories and concepts within fields of education. Nevertheless, the limited theoretical engagement combined with highly individualized research represents a key weakness of the literature base. This weakness is particularly important as scholars seek to generate reliable evidence to inform instructional change efforts in postsecondary STEM education.

The final weakness of the literature related to the relationship between research conducted and the problems surrounding teaching development. Two of the most commonly cited problems related to STEM education reform were (1) lack of preparation for teaching and (2) disciplinary culture. These concerns were commonly rehearsed in article introductions and rationales for studies in this review. The majority of the studies (N=66) in this review were related to the problem of preparation, while only 12 studies addressed the issue of culture. Studies that focused on preparation sought to design, implement, and evaluate teaching development activities. Comparatively, studies related to socialization and identity drew attention to how disciplinary cultures and environments shaped the experiences of STEM graduate students learning to teach. Ironically, the findings from studies of preparation were often explained as issues of culture, such as negative messaging (e.g., Gallagher, 2016) or devaluing of teaching in disciplinary contexts (e.g., Connolly et al., 2018). A weakness of this literature basis was the understudy and limited conceptualization of how culture potentially undermines the goals of STEM graduate student teaching development. This weakness is one that I sought to address for this dissertation.

Relevant to the current study, language-use was also underexamined in this literature base. As described above, only two studies explicitly discussed the role of discourse or interactions in teaching development; only the study by Stephens et al. (2017) described an analysis of talk. Proponents of socialization theory have argued that interactions - both formal and informal – have been central to graduate student development more generally (e.g., Austin, 2002; Austin & McDaniels, 2006), as well as for STEM graduate students learning how to teaching (e.g., Buck et al., 2006; Sandi-Urena & Gatlin, 2013). The absence of analyses of social interactions represents a significant gap in the literature on STEM graduate student teaching development. Furthermore, scholars have argued that a key methodological limitation of the literature base is in the reliance on retrospective, self-report data from surveys and interviews (e.g., Connolly et al., 2018; NRC, 2012). Only 21 studies in this review used data that were not self-report, 14 of which used observations. This literature base primarily provided evidence about what STEM graduate students think or know, but very few insights into their actual teaching practice. As some scholars have argued (e.g., Wyse et al., 2014; Ebert-May et al., 2015), what STEM graduate students know about teaching and how they act on this knowledge may not be reflected in self-report data. Additionally, only a handful of studies examined the actual practice of teaching development (e.g., Stephens et al., 2017). Taken together, the literature has done well to produce knowledge claims about STEM graduate students' psychological states (e.g., teaching beliefs) and, to a lesser extent, instructional practices, yet provided few insights into what participants (i.e., students, faculty, and institutional staff) *do* in teaching development activities to support instructional change.

## Chapter Summary

In this chapter, I discussed instructional change strategies, with a focus on STEM graduate students. Upon review of empirical studies of STEM graduate student teaching development, I described three themes across the literature related to assessments of teaching development, research approaches to study this topic and attention to culture, socialization, and identities in STEM disciplines. I concluded the chapter with an assessment of the strengths, weaknesses, and gaps in the literature. The next chapter describes the methodological frameworks, as well as the types of knowledge claims that can be produced to contribute to the literature on STEM graduate student and future faculty development.

# CHAPTER 3

# THEORETICAL AND METHODOLOGICAL ORIENTATION

## Chapter Overview

This chapter provides an overview of the theoretical and methodological orientation adopted for this dissertation. Specifically, I combine two related ethnomethodological frameworks, conversational analysis (CA) and membership categorization analysis (MCA) to study the sequential organization of categories-in-interaction (Sacks, 1972a; Hester & Eglin, 1997; Stokoe, 2012a) in teaching development for graduate students STEM disciplines. Ethnomethodology (EM) is a discipline developed by Harold Garfinkel and colleagues in the 1950s in the field of sociology (Garfinkel, 1967). The primary goal of EM is to describe the methods social actors use to produce shared meaning and social life in the routine activities of everyday life. CA is a distinctive ethnomethodological approach created through collaborations between Harvey Sacks, Emanuel Schegloff, and Gail Jefferson also in the field of sociology (Heritage, 1984; Sacks, 1992). The premise of CA is that social actors produce shared meaning and social life primarily through talk-in-interaction (Schegloff, 1987). As such, Sacks and colleagues argued that conversation was a key site wherein meaning-making and social life could be studied through systematic analyses of conversational interaction (Sacks, Schegloff, & Jefferson, 1974). MCA is another ethnomethodological approach that grew out of Sacks' (1972a, 1972b, 1979) early interest in how social actors use categories and through them produce social realities, identities, and cultures. Both CA and MCA investigate language-use as a medium for social action and share ethnomethodological principles to study social life in everyday and institutional settings (Stivers & Sidnell, 2013; Fitzgerald & Housley, 2015). These two approaches, however, have had a tenuous relationship and have been infrequently combined

(Hester & Eglin, 1997; Stokoe, 2012a, discussed further below). Through this study, I explore methodological engagement between CA and MCA following Stokoe's (2012b) recommendation for studies of *categorial systematics*. Further, I consider what new insights can be gained from an EMCA study of STEM graduate student teaching development, particularly as it relates to efforts to transform the culture surrounding teaching in these disciplines.

For this chapter, I first introduce key insights of EM. Next, I discuss the conceptual resources of CA and MCA that I will draw upon for this study. I then share a critique of ethnomethodological research based on published debates, critiques, and challenges with this approach to the study of language-use. Finally, I close the chapter with a discussion of my theoretical commitments and possibilities for this dissertation.

**Garfinkel's Ethnomethodology**

EM is a unique approach to social inquiry developed by Harold Garfinkel in the 1950s and 1960s (Garfinkel, 1967). Garfinkel defined EM as "the investigation of the rational properties of indexical expressions and other practical actions as contingent ongoing accomplishments of organized artful practices of everyday life" (Garfinkel, 1967, p. 11). The aim of EM is to characterize the methods (i.e., ethnomethods) actors use to collaboratively produce social facts, co-construct mutual intelligibility, coordinate social actions, and thereby produce a social order *as* stable through the routine activities of everyday life. Its object of study is the local production and situated character of social order. In other words, EM examines how actors *do* social life through moment-by-moment activities and practical reasoning. Garfinkel (1967) used juror decision-making processes in court cases to demonstrate how actors performed social life. Jurors in the study were asked how they were supposed to make decisions and what they considered a "good juror" (p. 109). They described pre-defined rules (e.g., maintaining a neutral stance) that were assumed to make juror decision-making distinct from that in everyday life. Garfinkel (1967) found that the actual decision-making practices of jurors did not match their prescribed roles or rules. Instead, he claimed that jurors accomplished verdicts through routine conduct for assessing course cases. Example activities included negotiating claims based on cultural knowledge, crafting interpretations *as* reasonable, and working to minimize the ambiguity of facts. Garfinkel (1967) argued that actors (and scientists) similarly worked to maintain the objectivity of the social world, though the practices for doing so were taken-for-granted. This observation had important implications that led to EM as an alternate to mainstream social inquiry.

For this section, I first discuss some of the backdrops of the development of EM. Garfinkel and Sacks were collaborators in the early development of EM, CA, and MCA (Garfinkel & Sacks, 1986; Sacks, 1992). While CA and MCA were further developed through engagement with various disciplines, Garfinkel's early writings in EM significantly influenced Sacks and colleagues (Maynard & Clayman, 2003; Sacks, 1992). With this context in view, I introduce some of the ideas central to ethnomethodology.

In Garfinkel's (1967) published collection, *Studies in Ethnomethodology*, he named the writings of Talcott Parsons and three phenomenologists - Alfred Schütz, Aron Gurwitsch, and Edmund Husserl - as influential in the development of his ideas. Parsons was Garfinkel's doctoral advisor. At the time, Parsons and was working with an interdisciplinary team of researchers to develop a unified theory of social action (Heritage, 1984; Parsons, 1949). An account of the context of Parsons' work and its relationship to Garfinkel is provided by Heritage (1984) in *Garfinkel and Ethnomethodology*. Here, I describe some aspects of Parsons' (1949) work on the Voluntaristic Theory of Action that is related to EM, and subsequently, CA and MCA.

To develop his theory of action, Parsons (1949) analyzed the works of four social theorists, Emile Durkheim, Alfred Marshall, Vilfredo Pareto, and Max Weber. Parsons argued that the theories proposed by these four theorists converged into a common or unified theory of action. From his analysis of their works, Parsons (1949) developed the concept of the *unit act*: the basic unit of analysis for systems of social action. The unit act included four parts: (1) an implied actor or agent, (2) an end or future state affairs to which action is oriented to, (3) a situation or circumstance of action, and (4) a means for actions that are shaped by norms or a "normative orientation" (Parson, 1949, p. 44-45). The elements of the unit act, Parsons argued, could provide a holistic conceptual scheme for social inquiry. The analysis Parsons (1949) undertook was ambitious. In his pursuit of a universal approach to social inquiry, however, I believe that he undervalued the importance of diverse perspectives to studying the social world. Nevertheless, Parsons provided a useful framework for making analytical distinctions between aspects of social action.

Parsons (1949) described four key implications of his unified theory of action that are particularly relevant to Garfinkel's (1967) early conception of EM. These implications were related to (1) points of view, (2) time, (3) choice of means of actions, and (4) circumstances of the action. First, Parsons (1949) described that both subjective and objective points of view were involved in the empirical analysis of actions. He argued that the facts of actions were objectively available to scientist observers (i.e., objective point of view). Parsons also claimed that while scientists were not to be concerned with their own minds, they were concerned with the minds of social actors (i.e., subjective point of view). He described social scientists' interest in the subjectivity of actors to mean that they were concerned with understanding aspects of social actions "*as they appear from the point of view of the actor* whose action [was] being analyzed and considered" (p. 46, emphasis in original). Here, Parsons made a distinction between the point of view of social scientists and actors. Garfinkel (1967), by contrast, argued that scientists and laymen alike acted as sociological inquirers, worked to make sense of each other's' points of view, and analyzed each other's' actions in everyday activities. Further, he argued that social actors displayed their points of view and actions so that they could be *recognized* for what they were. Garfinkel (1967) was interested in understanding how social actors worked to make their points of view and actions publicly available and recognizable. The methods (i.e., ethnomethods) social actors used to make their actions and points of view available in routine activities would become the core of the program of EM.

Second, Parsons (1949) claimed that because actions were oriented to future states of affairs (i.e., ends), time was an organizing feature of action. As we will see below, time and sequence are a central consideration in ethnomethodology, CA, and MCA (Garfinkel, 1967; Sacks, 1992). Regarding the third implication, Parsons (1949) suggested that actors had a choice in the means of producing social actions. This choice, he argued, was shaped by a normative orientation. According to Parsons (1949), a normative orientation meant that social actors behaved *as if* there was a correct way to perform their actions. He suggested that while many normative orientations were possible, social actors were limited by what appeared to be commonly known standards or norms for acting. Further, Parsons (1949) argued that shared knowledge of norms was required for a normative orientation. It also meant that both "error" and the "right choice" for the means to particular ends were possible (p. 46). Parsons (1949) argued that social scientists, therefore, needed conceptual resources to make analytical distinctions between “normative” and “non-normative” aspects of social actions (p. 49). He conceived of norms as internalized knowledge shared by all members of society and considered these to be central for explaining social action. For Garfinkel (1967), however, it was unclear how it was possible for norms to guide actions. He theorized that actors must be able to *recognize* norms and know how to act on them. Garfinkel (1967) argued that interpretation, rather than passive guidance from internalized knowledge, was required for there to be a normative orientation to social action. This point of departure between the two theorists would ultimately be significant for how Garfinkel would theorize the production and re-production of social knowledge.

The final implication Parsons (1949) described was pertaining to the aspects of the situation or environment of action. He described the subjective point of view of the actor as the ego or self that was separate from the body. The body, Parsons argued, formed the primary external environment for the situation of action. Further, he suggested that the actor and the situation were indistinguishable. Here, Parsons separated the mind from the body to describe aspects of the environment of action. Though Parsons’ (1949) expressed a commitment to developing theory based on empirical studies, it is unclear whether the mind-body dualism he suggested was empirically justified. Garfinkel (1967), by contrast, was concerned with public displays of understanding and the involvement of the body. As Maynard and Clayman (1991) have argued, Garfinkel rejected the mind-body separation in favor of a sociological analysis of the “corporeity of so-called subjective behavior” (p. 390). Specifically, Garfinkel (1967) was concerned with the embodiment of actions as a form of practical reasoning whereby social actors made their views publicly available for situations at hand. Parsons’ (1949) mind-body separation and Garfinkel’s (1967) emphasis on public reasoning represented a key distinction between their approaches to subjectivity.

The constitutive phenomenology of Alfred Schütz was influential in Garfinkel's (1967) theorizing about the practical reasoning and subjectivity experience. Phenomenology is a field of inquiry concerned with the study of the structures of subjective experience from the first-person point of view (Smith, 2013). According to Psathas (2012), Garfinkel read several of Schütz's (1962a, 1962b) papers and saw that it was possible to demonstrate – empirically – how inner life was made visible in and for interaction. Garfinkel (1967) cited Schütz's ideas as intellectual resources to clarify how a common sense of the social world was possible, how this sense of the world related to social action, and how social actors observably demonstrated their imaginings of how society worked. Garfinkel noted that he was indebted to Schütz's scholarship, particularly his phenomenological writings about three topics: (1) the "attitude of everyday life", (2) typified experiences, and (3) rationality (Garfinkel, 1967, p. 37, 106, see also Chapter 8). A full discussion of the connections between Schütz's scholarship and Garfinkel's uptake of his ideas is beyond the scope of this chapter (see Heritage, 1984 and Psathas, 2012 for extended accounts). I do, however, want to discuss Schütz's (1962b) concept of typicality because it is related to the focus of MCA on how social realities, identities, and cultures are implied by actors within social interaction.

The concept of typicality must be situated within the connection between Schütz's (1962a, 1962b) natural attitude and Garfinkel's (1967) interest in mundane reason. Both mundane reasoning and natural attitude referred to the "seen but unnoticed background expectancies" that social actors appeared to rely on in everyday life (Garfinkel, 1967, p. 37). Said another way, they argued that actors made assumptions about the social world and treated reality as natural, familiar and unquestioned, while at the same time participating in the constitution of the social world *as* natural, *as* familiar, and *as* unquestionable in daily conduct

(Pollner, 1991). Schütz (1962a) argued that the shared familiarity and common sense of the world were possible, in part, because individuals experienced the world in typified ways. An example of this is how a chair, a type of object with a seat and legs, set the stage for similar objects to be predictively known and experienced as a chair in the future. Schütz (1962a) argued that because language was adaptable, the way that different types of objects were characterized could be revised. This supported Garfinkel's (1967) claim about the contingent character of how actors produce the social world. Pertaining to actions and intersubjectivity, Schütz (1962b) argued that actors had standard (i.e., typified) ways of behaving and that social actors judged each other's' actions against their typifications. Garfinkel (1967) drew from Schütz's concept of typicality to explain how objects (e.g., places, people, actions) could be produced and, through interpretation, be recognized as familiar. While Garfinkel (1967) borrowed this idea, he expressed dissatisfaction with Schütz's (1962a, 1962b) lack of empirical evidence to support it. Still, the practices of typification, particularly how language is used to produce types, is a phenomenon of interest in ethnomethodological work. The analytic focus of MCA, for example, is how social actors use and treat categories (e.g., 'student,' 'learner,' 'STEM') in the everyday life (Hester & Elgin, 1997). Thus, MCA can be conceived of as an analysis of typification practices. Importantly, the use of types in routine activities afforded Garfinkel (1967) evidence that social actors presumed and interpreted social knowledge for their future actions.

Garfinkel (1967) also borrowed from Karl Mannheim the idea of the documentary method of interpretation. This idea described how social actors contextualized the knowledge at hand in terms of past experiences and expectations, much like what might happen in the production of documentary film. This meant that social actors could use what happened in the past (e.g., experiences with types of objects) as resources to inform current interpretations and future actions. An example of this can be drawn from Garfinkel's (1967) breaching experiment. These experiments were designed to disrupt 'normal' to demonstrate what counted as 'normal.' To do this, Garfinkel's (1967) students were given the task of using predetermined yes and no answers during counseling interactions. One subject, for example, requested advice about dating someone from a different faith. The experimenter (one of Garfinkel's students) was restricted to answering yes or no according to the predetermined script, without regard for the questions being asked. Across these experiments, Garfinkel (1967) found that yes and no responses to questions, whether appropriate or not, were treated as answers to questions and were used to make relevant particular histories and next lines of questions. Garfinkel (1967) argued that a documentary method of interpretation was also a feature of sociological inquiry:

> The documentary method is used whenever the investigator constructs a life history or a "natural history". The task of historicizing the person's biography consists of using the documentary method to select and order past occurrences so as to furnish the present state of affairs its relevant past and prospect. (p. 95)

Thus, biography, which could be viewed as having a natural, chronological character was also conceived of as the product of *selective* and *partial* recountings for the practical purposes at hand. Pollner (1991) argued that the contingent and constituted character of social life was one of the most significant contributions of Garfinkel's theory. This insight had important methodological implications about knowledge and the role of researchers in producing knowledge claims. As Pollner (1991) argued, by demonstrating all accounts and knowledge claims were partial and selective, Garfinkel implicated researchers in the production and maintenance of particular versions of society. From my perspective, this idea warranted consideration both about what comes to pass as valid or real knowledge and the need to reckon with practical reasoning as a necessary condition of knowledge.

The works of Parsons and Schütz (among others) were critical to the development of EM. Heritage (1984) characterized Garfinkel's ideas as a response to Parsons' theorizing. Rawls (2002), however, argued that it was a mistake to construe Garfinkel's development of EM as a response to Parsons. Rawls claimed that Garfinkel's ideas were developed in his studies before work with Parsons, though the Voluntaristic Theory of Action raised important questions for him about how to approach social inquiry. Additionally, Lynch (2012) argued that Garfinkel's approach could be conceived of as adding nuance or elaborating aspects of Parsons' voluntaristic or active conception of social action. Parsons (1949) proposed his theory as an alternative to a positivistic or causal conception of social action. For Parsons, the social actor was agentic and rational, yet constrained by a normative orientation in society. This conception was congruent with Garfinkel's (1967) conceptualization of social actors, though distinct in important ways as it pertains to social knowledge, such as norms. Importantly, Garfinkel (1967) raised questions about the status of points of view and actors' knowledge about how to act in given situations. Additionally, he argued that these concerns were implied or taken-for-granted in social research.

Garfinkel (1967) was also critical of researchers' treatment of actors' knowledge and understanding, particularly as "cultural dopes," in mainstream sociological theory (p. 68). Investigators, he argued, constructed social actors as "dopes" who were passively guided by norms or culture, for example, to act in restricted ways (p. 68). Alternatively, Garfinkel (1967) suggested that social actors were artful, skilled, reflective, and active in their participation in society and the production of social order. His conceptualization of the social actor as an involved, rather than passive, provided and agentic, social view of actors. This is particularly compelling to me for considering how social actors could produce the social world differently. Related to this dissertation study, the category 'scientist' has been strongly associated with research activities and often excluded teaching as part of that professional identity (Brownell & Tanner, 2012). Anderson et al. (2011) argued that the distinction between research and teaching, however, was "artificial" and built through a range of institutional practices that privilege some academic activities over others (p. 152). These scholars have recommended shifting the culture and practices in scientific disciplines so that teaching practices would be normalized. In alignment with Garfinkel's (1967) conception of social actors, Anderson et al. (2011) claimed that participants in scientific communities were active participants in signaling values, creating policies, and establishing practices that structurally devalued teaching. For me, this also opened the possibility of alternative ways of doing social and professional life for scientists.

With the aforementioned influences and points of departure in view, I now outline some of the key insights from Garfinkel's (1967) conception of EM. Of note, some scholars have observed shifts in Garfinkel's work and ideas over time (e.g., Pollner, 2012; Rawls, 2002). I have restricted this discussion to the early articulation of EM that was written around the time of Garfinkel's collaboration with Harvey Sacks (Garfinkel, 1967; Garfinkel & Sacks, 1986). Below I discuss four of Garfinkel's (1967) key insights: (1) the intelligibility of social action, (2) shared methods for sense-making, (3) the production of social knowledge (e.g., norms), and (4) the skilled design of social actions.

First, Garfinkel (1967) observed that actors treat each other's actions as intelligible and empirically available for analysis for the practical purposes at hand. He observed that speakers, for example, treated their points of view as empirically available for hearers to analyze. Garfinkel (1967) found that if an account from a social actor was unclear or did not fit with the presumably shared objective circumstances, hearers would request explanations or interpreted answers in terms of prior knowledge (i.e., documentary method of interpretation). Whether words were a good or bad fit was not based on the dictionary definitions or meanings, per se. Rather, Garfinkel (1967) argued that due to the indexical nature of language, intelligibility of action relied on situational features, such as timing, location of utterances, and other features of everyday settings.

Second, Garfinkel (1967) theorized that social actors (laymen and social researchers alike) relied on the same methods for social analysis in everyday life and scientific studies. Garfinkel and Sacks (1986) were against the distinction between the reasoning of scientists and laypersons and asserted that scientific reasoning had no special logic compared to practical sense-making. Using the example of research coding, Garfinkel (1967) argued that protocols ought to be read as rhetorical practices. He argued that protocols provided "a "social science" way of talking to persuade consensus and action within practical circumstances" (Garfinkel, 1967, p. 24). He claimed that social actors, scientists and laypersons alike, similarly posited and acted on knowledge claims about the social world, analyzed each other's actions, and treated each other's talk and conduct as consequential (or data) for future actions. Garfinkel (1967) described these activities as a form of practical reasoning that was involved in the ongoing production of everyday life.

Instead of conceiving social knowledge, such as norms, as *a priori* internalized, stable understandings of society held by all social actors as Parsons (1949) did, Garfinkel (1967) theorized that social actors produced and reproduced social knowledge through the routine activities of everyday life. Garfinkel rejected the use of *a priori* theoretical frameworks for the study of common-sense knowledge in favor of a focus on what social actors actually did. Further, he advocated for the empirical study of the sense-making practices of actors to understand how they produced social knowledge such that it was unquestioned and treated *as* natural. Through ethnomethodological studies, Garfinkel sought to characterize methods social actors used to produce a social world *as if* it were stable and concrete.

Related to the production of social knowledge, Garfinkel (1967) theorized that social actors behaved in ways that displayed their reliance on a presumably shared knowledge of the social world. Said another way, social actors make visible their understanding of social life through everyday activities, interactions, and dialogue. Garfinkel and Sacks (1986) argued that social actors used language as a central medium for displaying and claiming knowledge about the social world. Thus, the production and re-production of norms, Garfinkel (1967) argued, involved using language or action to produce social knowledge and make claims about the social world. The concreteness of the social world, he claimed, was produced through cycles of acting on or responding to a particular sense of the social world.

Finally, Garfinkel (1967) observed that social actors *designed* their actions to be recognizable and intelligible. He argued that social actors were skilled, artful, and creative in designing their actions to be understood by others. Garfinkel (1967) argued that mainstream theorizing, by contrast, treated social actors as passive, rather than active participants in the production of social life. He further concluded that shared sense-making practices were pre-requisites for social actors to be able to successfully design actions to achieve shared meaning.

In summary, EM represents a unique perspective to analyzing how actors work together to *do* social life. Garfinkel (1967) argued that social actors were skilled in their coordination and production of social life through a practical rationality. This had significant implications for what counted as rational behavior (Garfinkel, 1967, see Chapter 8). Whereas Parsons (1949) limited the definition of rational actions to those actions that successfully achieved specific ends through the right means, Garfinkel (1967) demonstrated the flexible means through which social actors achieved various (contingent) ends. Garfinkel's (1967) ideas, thus, broadened the scope of what could be included as rational behavior by shedding light on how some actions could be produced as rational and others produced as irrational. Whether rational or irrational, both types of actions required skillful coordination between social actors to achieve these characterizations. Therefore, EM provided an empirical basis for making sense of what, on the surface, seemed unintelligible (Garfinkel, 1967). These principles form the foundation of CA and MCA, two ethnomethodological approaches wherein actors *do* social life, turn-by-turn, in conversation.

**Conversation Analysis**

CA is the qualitative study of the sequential organization of talk-in-interaction. Specifically, CA is an ethnomethodological approach to study how social actors produce shared meaning and social life through talk-in-interaction (Heritage, 1984; Sacks, 1992; Schegloff, 2007). Notably, in the 1960s, Sacks and colleagues proposed the analysis of conversation as a data-driven approach to theorizing how actors work to produce shared meaning and social life as an alternative to abstract, theory-driven approaches common in sociology (Sacks, 1963; Sacks, Schegloff, & Jefferson, 1974). Based on observations and empirical studies of recorded conversations, the founders of CA theorized that turn-taking was a central method by which social actors' co-constructed mutually intelligible meaning and produced social life (Sacks et al., 1974). This observation made conversation as a site for doing sociology that continues to define the research program of CA (Sacks, 1992, Stivers & Sidnell, 2013). The primary aims of CA are to identify and characterize the methods and practices social actors use to make sense of each other within social interaction (Lester & O'Reilly, 2019). Analyst study how social actors *use* language to perform social actions and co-construct meaning. Thus language-use, on one hand, is considered a vehicle for doing social actions. On the other hand, language-use serves as a site for doing sociology through detailed analyses of what social actors can do with language, what language can do for social interaction, and how social actors achieve local social order within interaction (Sacks, 1984).

In this section, I first discuss some of the key intellectual and methodological influences of CA. The development of CA is described in various seminal works by key contributors to this approach (Heritage, 1984; Maynard, 2013; Sacks, 1992). It is beyond the scope of this dissertation to provide another account of the development of CA. Instead, I focus on outlining some of the key ideas and influences that shape the method of CA. Next, I discuss the core assumptions of conversation analytic and related research. Then I introduce the conceptual framework for conversational structures that I will draw from for this ethnomethodological study. The concepts used to describe conversational structures are based on Sacks et al.'s (1974) empirical studies of recorded conversations. These technical concepts provide theoretical resources for describing how social actors collaboratively produce shared meanings and perform social actions.

***Influences of CA***

Sacks and colleagues were significantly influenced by Harold Garfinkel's ethnomethodology and Erving Goffman's concept of the interaction order (Maynard & Clayman, 1991; Sacks, 1992). Across the accounts of the history of CA, two ideas have been considered foundational to the research program (Stivers & Sidnell, 2013). First, interactions are assumed to be ordered institutions in their own right made possible through shared methods of sense-making and action. Second, this interaction order and the actions produced are the basis of all social interactions and institutions. These two ideas were influenced by the works of Goffman's (1983) concept of interaction order and Garfinkel's (1967) EM. Additionally, Sigmund Freud and various fields of social and behavioral science offered key insights that shaped what is now known as CA (see Lester & O'Reilly, 2019 and Sidnell, 2010 for further discussion of this). Below I discuss three key influences of the method of CA: (1) EM, (2) Goffman's interaction order, and (3) anthropology and ethnography.

**Ethnomethodology.** As described above, Garfinkel's early conception of EM significantly influenced the work of Harvey Sacks, one of the founders of CA. Sacks described "ethnomethodology/conversation analysis" as a domain of research that "seeks to describe methods persons use in doing social life" (Sacks, 1984, p. 21). Sacks and Garfinkel met at Harvard (1959-1960) and collaborated until Sack's death in 1975 (Maynard, 2013). They shared a commitment to describing the methods actors use to produce social life through empirical studies of routine activities of everyday life. CA has been commonly described as a form of ethnomethodological research (Heritage, 1984; Maynard & Clayman, 1991). Some scholars, however, have argued that the methodological connections between EM and CA have not always been clearly articulated in the literature (Maynard & Clayman, 2003; Seedhouse, 2004). Here I focus on three sets of related concepts to make the connection between EM and CA clear: (1) indexical expressions and sequential organization; (2) embodied action and conversational procedure; and (3) breaching experiments and deviant cases.

Maynard and Clayman (1991) described two sets of related concepts between EM and CA: (1) indexical expressions and sequential organization; and (2) conversational procedures and embodied action. First, Garfinkel and Sacks (1986) claimed that social actors were masters of "natural language" (p. 160). The term natural language, however, did not describe specific dialects or grammar. They instead conceived natural language as a system of flexible practices social actors used for speaking and hearing. Garfinkel and Sacks (1986) argued that that natural language was indexical and the meanings of the talk were situated with routine activities of daily life. The notion of indexicality referred to the idea that the meaning of a word depended on the context of its use. This means that what is said just before an utterance, along with the environment (i.e., body, location), would shape how what was said next would be heard and understood. Therefore, the setting and sequence of the talk were important for how utterances are understood. Following this idea, the founders of CA theorized that social actors tied utterances together in sequence through the method of turn-taking (Sack et al., 1974). Through turn-taking, they argued, social actors collaboratively constructed the meanings of utterances that would be unintelligible on their own (e.g., ‘I have to’ or ‘me’). Thus, the notion of indexicality from EM is closely related to CA’s focus on sequential organization produced through turn-taking.

The second set of related terms between EM and CA are embodied action and conversational procedures (Maynard & Clayman, 1991). Garfinkel (1967) was concerned with talk and other forms of conduct as embodied, displayed actions. While he did not deny cognitive processes, Garfinkel deemphasized attention to mental activity in favor of a focus on visible, public, and accountable activity (e.g., talk, movements, the body, etc.) (Garfinkel, 1967; Maynard & Clayman, 1991). Whereas EM attended to various forms of conduct, CA focused exclusively on the conversational procedure as a form of embodied action (Maynard & Clayman, 1991). Gail Jefferson (2004), one of the founders of CA, developed a distinctive transcription system to represent the varied resources, both vocal and non-vocal (e.g., pauses), that actors use to perform social action within conversations. Whereas other forms of transcription included only words or gists of research data, CA transcription practices attended to *how* things are said and how social actors performed specific actions through these sayings in social interaction (Hepburn & Bolden, 2017). The commitment to attending to actions performed in conversation was further evidenced by transcription systems developed by Goodwin (1981) and Mondada (2001) to describe visible conduct in social interaction. EM and CA, then, share a goal of describing embodied action, though CA focuses exclusively on conversational procedures.

The third set of related concepts are derived from Garfinkel's (1967) breaching experiments. Garfinkel conducted several experiments that demonstrated his key insights and showed how social actors handled disruptions in their presumably shared social realities. Participants in Garfinkel's (1967) breaching experiments were often shocked, surprised, or even angry when student experimenters asked questions that disrupted their presumably shared knowledge and expectations of the objective world. He also observed that when contradictions about the objective world would arise, social actors attempted to fix these reality disjunctures (Pollner, 1991) by ascribing flaws to points of view so that the objectivity of the social world could be maintained (Garfinkel 1967; Maynard & Clayman, 1991). Breaches or reality disjunctures in EM are analogous to deviant cases in CA (Maynard & Clayman, 2003; Seedhouse, 2004). A deviant case is an instance of social interaction that demonstrably falls outside of the norm (Peräkylä, 2011). As with breaching experiments, deviance of actions was defined by how social actors treated specific courses of action as unusual (e.g., being shocked, upset, etc.). Deviant cases are important in CA because they both violate and demonstrate the normative orientation within interactions. Therefore, the connection between EM and CA here is the use of the idea of breaching-like cases as analytical resources for grounding claims in CA.

While CA can be conceived of as a kind of EM, Maynard and Clayman (1991) argued that CA has distinctive features and a unique trajectory separate from the broader program of ethnomethodology. Sacks and colleagues were credited with theorizing and characterizing the locally produced orderliness in conversational interaction (Sacks et al., 1974; Rawls, 2002).

Additionally, Sacks and colleagues proposed the analysis of conversational interaction as a novel approach to doing sociology (Sacks, 1963; Sacks et al., 1974). Ethnomethodological inquiry does not require a specific method beyond the research policy to describe the methods social actors use to produce social life by examining what members orient to and treat as consequential in social actions (Garfinkel, 1967; Maynard & Clayman, 1991). By contrast, CA provided a distinctive method for analyzing social interaction (Heritage, 1984; Maynard & Clayman, 1991). CA researchers conduct turn-by-turn analyses of talk-in-interaction to describe how social actors work together to construct shared meaning and intelligibility within a conversation. In addition to Garfinkel, Sacks and colleagues were influenced by various fields described below.

In sum, the principles of EM significantly shaped the theory and method of CA. Schegloff (1992) claimed that Sacks and Garfinkel had key disagreements about the purpose of research. Although they shared a commitment to studying with the local production of social life, Sacks (1984) was interested in developing an observational natural science of social interaction. By contrast, Garfinkel (1967) considered the description of the members' methods to be the main task of EM and was opposed to a scientific study of the production of social life (see also, Garfinkel, 2002, for further discussion of this). These distinct goals are evident in contemporary literature in CA and EM. CA researchers have developed an extensive technical catalog for analyzing and describing social practices (Schegloff, 2007a). By contrast, ethnomethodologists have worked to produce detailed descriptions of the distinct features of various work activities based on first-hand experience (Garfinkel, 2002). Despite separate goals and trajectories, CA manifests as an application of some of the principles of EM.

**Interaction Order.** Erving Goffman, who was a doctoral advisor of Sacks, influenced CA with his notion of the interaction order (Maynard, 2013). Goffman (1983) argued that face-to-face interaction was an important domain for studying social order. He argued that social interaction was an institution with sets of social obligations, identities, norms for action, and was organized or ordered (hence, interaction order). Notably, Goffman (1983) claimed that social interactions mediated the everyday business of social life and served as the foundation of all other institutions (e.g., economic, political, education). Heritage and Clayman (2010) argued that Goffman's key contribution to CA was the conception of the interaction order as a structured institution in its own right. Specifically, because interactions were normatively organized, face-to-face interactions could be analyzed to understand how social actors achieved this order. The founders of CA sought to study the structure of social interaction and characterize its orderliness (Sacks et al., 1974). Similar to how Goffman (1983) considered face-to-face interaction to be foundational to all other institutions, Sacks et al. (1974) theorized that everyday conversation was foundational for all other forms of speech exchange (e.g., debates, interviews). Heritage and Clayman (2010) argued, however, that Goffman's work was distinct from CA as he was not concerned with how actors made sense of each other in social interaction. Nevertheless, the founders of CA borrowed from Goffman the concept interaction order and combined it with EM to systematically analyze how social order was achieved within social interaction.

**Anthropology and Ethnography.** According to Heritage (1984), audio recording technology fundamentally changed how social research was conducted in the 1960s. In anthropology and ethnography, handwritten field notes and researchers' reflections about interactions were common practice during that time. While Sacks was drawn to the study of culture and everyday life as done in those disciplines, he was critical of the methods for generating data (Maynard, 2013). Sacks (1984) was especially in favor of using audio recording given his goal to develop an observational science of social interaction in everyday life. He advocated for the use of audio recordings of conversational data for two reasons. First, it allowed analysts to replay data multiple times to produce detailed hearings. This related to the commitment to the reproducibility of findings in CA (Maynard, 2013). The second benefit Sacks (1984) cited for using audio recordings was that other researchers could be certain that, at the very least, what was recorded actually happened. He claimed that recordings also provided opportunities for other researchers to disagree with his interpretations. Sacks' (1992) engagement with anthropology and ethnography, then can be viewed as critique a of the research methods that were used, yet still informed his pursuit of alternative approach studying everyday life.

### ***Key Characteristics of CA***

In this section, I introduce some of the key characteristics of CA. Stivers and Sidnell (2013) discussed five characteristics of CA. First, that social interaction or language-in-use is orderly at fine-grain detail (Sacks et al., 1974). Second, the phenomena of interest in CA is the locally accomplished social order, shared meaning, and mutual intelligibility. CA researchers seek to analyze talk-in-interaction in an effort to describe how social actors achieve orderliness. Relatedly, the third characteristic is CA's goal to identify and describe structures that underlie social interaction. In general, ethnomethodological approaches adhere to the practice of *ethnomethodological indifference* (Garfinkel & Sacks, 1986). This can be described as an effort to avoid judging whether actions were right or wrong in an effort to place emphasis on the actual conduct of social actors. CA researchers also prefer naturally-occurring recordings of social interaction to study the fine-grain details of social conduct. Sacks (1984) argued that recordings of actual events were preferred to handwritten notes because others could not deny that they represented some aspects of the real world. Additionally, everyday conversation has been the primary domain of analysis (Sacks et al., 1974; Heritage & Clayman, 2010). Sacks et al. (1974)

suggested that other forms of speech-exchange (e.g., debates, singing) were adaptations of ordinary conversation. Thus, it was assumed that studies of ordinary conversation provided the fundamental structures for all forms of language-use. The fourth characteristic of CA is the use of the transcription system developed by Gail Jefferson (2004) to represent how things are said. The emphasis on *how* words are said points to the emphasis in CA on how language can be used to perform multiple actions (Sacks, 1984). Finally, CA is an inductive qualitative method used to make local generalizations about human conduct.

***Conceptual Framework for Structures of Conversation***

Seven concepts that describe basic conversational structures form the conceptual framework of conversation analytic research: (1) sequence organization, (2) adjacency pairs, (3) turn design, (4) turn constructional units and transitions, (5) speaker selection, (6) preference organization, and (7) repair.

Sequence organization refers to how meanings and intelligibility of utterances or actions depend upon their location within courses of talk-in-interaction (Schegloff, 2007). Garfinkel and Sacks (1986) argued that the indexical expressions are a feature of natural language. This means that the meaning of an utterance is not fixed in advance of words being expressed. As such, social actors must have discursive practices for concretizing the meanings of their utterances and making them intelligible for each other. Garfinkel and Sacks (1986) observed that social actors understood utterances in relation to their local or immediate circumstances. These circumstances involved (at least) what happened just before an utterance and the context within which it was said. Thus, interactants co-produce meaning and intelligibility through indexing practices that rely on timing and are situated in specific contexts. The concept of sequential organization also relates to Garfinkel's (1967) notion of *reflexivity*. In EM, reflexivity refers to the fact that the same methods social actors use to produce their actions to be intelligible are used to create circumstances for future actions and utterances. This means that current actions and talk shape and create the circumstances for future action and talk. These things considered, the sequential organization is achieved by interactants through practices for making the meanings of the things they do and say concrete over time and contexts.

A concept closely related to sequential organization is the adjacency pair. Social actors can be observed 'tying' pairs of utterances that are next to each other together as a way to co-construct meaning and make sense of each other's actions (Schegloff & Sacks, 1973; Maynard & Clayman, 2003). Features of adjacency pairs include the following: (a) two turns, (b) turns are completed by at least two different speakers, (c) turns are adjacently placed, (d) turns are ordered, and (e) pair-types are conventionally related (e.g., question-answer) (Schegloff, 2007). A part of an adjacency pair is typically labeled as the first pair part (FPP) or second pair part (SPP) (Schegloff & Sacks, 1973). In sequence, an FPP can be used to make sense of the next pair (SPP) that would otherwise be unintelligible. For example, 'where are you' as an FPP from one speaker paired with 'home' as an SPP from another speaker is a question-answer adjacency pair. Depending on the interactional circumstances, the FPP could be understood as a request for information about the physical location of the second speaker. Alternatively, the same FPP ('where are you') could be heard as a complaint and produce an apology ('I'm sorry ') as an SPP in a different interactional circumstance. In sequence, then, social actors pair utterances to produce shared meaning within social interactions.

Garfinkel (1967) claimed that social actors artfully and skillfully produce their actions to be understood in particular ways. The skilled construction of actions describes a third CA concept, turn design. Turn design refers to the ways social actors construct their turns to perform specific actions so that they will be recognized and understood as doing those actions (Drew, 2013). Turns can be built using various linguistic and non-verbal communicative resources, such as words, timing, and gaze.  In CA, the resources used to construct turns are called turn constructional units (TCUs) (Sacks et al., 1974). Schegloff (2007a) described three criteria when a TCU or single turn is recognizable for participants in interaction as complete so that a new turn may be taken. First, the grammatical form can shape whether a turn is recognized as complete. Grammatical forms include sentences, phrases, or lexical items (e.g., yes, no). The intonation or phonetic aspects talk is another social actors can signal to others that a turn is coming to an end. The third aspect of completion is related to whether the action being done with talk is complete. Taken together, turns are built with parts (labeled as TCUs) that are treated as grammatically, prosodically, and pragmatically (i.e., action) complete by participants in an interaction. Turn design and the parts that construct turns relate to two additional concepts to describe speaker transition and turn allocation.

Sacks et al. (1974) observed that slight overlaps occur primarily at the ends of turns of conversation. They observed that speaker change occurred often and that typically only one person was speaking at a time. The authors theorized that social actors must have interactional practices for transitioning and allocating to coordinate turn-taking. The term transition relevant point (TRPs) is used to describe moments where social actors orient to the turn of speakers as complete (Schegloff, 2007). Within a turn, the next speaker is chosen or their response is warranted (e.g., a question directed at a specific person). Sacks et al. (1974) observed three types of speaker selection: (1) the current speaker selects a new speaker, (2) a speaker self-selects, or (3) the current speaker continues. The way speakers design their turns to be heard as complete and the methods they use for selecting the next speakers allows for a smooth progression of the conversation.

The progressivity of talk-in-interaction relates to the concept of preference organization. The sense of preference refers to how social actors treat courses of action as usual and unproblematic (Seedhouse, 2004). This contrasts with dispreferred conduct (e.g., breaching experiments), which is treated as different from wat normatively expected. In Garfinkel's (1967) breaching experiments, in which research participants received unexpected responses from interviewers in counseling interaction, participants were often shocked or requested explanations. The unexpected responses were treated or oriented to as dispreferred because they disrupted the flow and progress of conversation. Conversations with preferred responses, by contrast, typically proceed without delays, pauses, or other markers that signal trouble. Therefore, as Sacks' (1984b) observed, conversation procedures are organized by preference.

Garfinkel (1967) observed that when breaching experiment participants received unexpected or inappropriate responses, they attempted to fix them to carry the conversation forward. Participants often did this by rationalizing the answer or by ascribing flawed perspectives to others. Related to this, the concept of repair in CA refers to the practices social actors use to manage and correct dispreferred responses in interaction. Schegloff, Jefferson, and Sacks (1977) described four types of repair: (1) self-initiated repair, (2) other-initiated repair, (3) self-initiated other-repair, and (4) other-initiated repair. These forms of repair also have a preference organization. The preferred response to an error is for the current speaker who makes the error to correct themselves (1), whereas the least preferred response to trouble in interaction is for another person to correct the current speaker (4). However the repairing practices manifest, they are ultimately designed to maintain the continuity of talk-in-interaction.

### *Branches of CA Research*

Three branches of research were developed from the work and interests of Sacks and his collaborators: traditional or basic CA, institutional or applied CA, and MCA. These approaches have some overlap, though they vary in analytic focus. Below I briefly discuss the two forms of CA and reserve a separate section for the discussion MCA.

**Traditional or Basic CA**. Though some of the earliest work in CA took place in institutional settings (e.g., Sacks, 1972a), traditionally CA was focused on identifying the basic practices social actors used for organizing turns in everyday conversation (Sacks et al., 1974). Sacks et al. (1974) studied recordings of naturally occurring everyday conversations to describe the “simplest systematics” for organizing turns in conversation (p. 701). The simplest systematics included two components, turn construction and turn allocation, and various observable rules social actors enacted (refer to the section above on conversational structures). The analytic focus of basic CA has been characterizing these practices. The organizing practices that take place in everyday conversation is considered as foundational for all other forms of speech exchange (e.g., interviews, ceremonies).

**Applied or Institutional CA**. The sense of application is based on Sacks et al.’s (1974) observation that other types of speech-exchanged had specialized turn-taking practices. They argued social actors adapted basic organizing practices for other interviews and debates. Institutional or applied CA became an increased focus inquiry 1970s with the publication Atkinson and Drew’s (1979) *Order in Court* (1979). The general analytic focus of applied CA is how the context-specific norms, identities, and institutional goals potentially shape how interactants conduct their business (Maynard & Clayman, 2003).

Whether the foundationalist claim about everyday conversational structure was warranted or empirically-based is debatable (Billig, 1999; Hammersley, 2018). Recently, CA scholars have drawn attention to the fact that what could be characterized as everyday conversation occurs within institutional settings (e.g., Heritage & Clayman, 2010). Likewise, instances in everyday social interaction may have an institution-like character. Heritage and Clayman (2010) conceded that the line between everyday and institutional talk is blurred. Given the potential overlap between these two forms of talk, conversation analysts have warned warn that claims of the institutionality of social interaction must be demonstrated and cannot be presumed in advance of analysis (Schegloff, 2007; Heritage & Clayman, 2010).

The distinction between structures in everyday conversation and other speech-exchange systems (e.g., debates, interviews, institutional talk) is what separates traditional and applied CA. Whereas traditional CA is primarily concerned with describing generalizable structures of conversational practice, applied CA considers the context-specific ways in which turns of talk are used to produce social actions in institutional settings (Clayman & Maynard, 1991; Heritage & Clayman, 2010). Antaki (2011) described six different types of applied CA that have distinct purposes (Table 3).

Table 3

*Six Types of Applied Conversation Analysis*

| Type | Purpose |
|---|---|
| *Communicational* | Understand features of disordered to generate criteria communication problems for specific disorders (e.g., aphasia) |
| *Diagnostic* | Diagnose disorders |

| | |
|---|---|
| *Foundational* | Re-specify mentalistic constructs (e.g., beliefs) in terms of action and public conduct |
| *Institutional* | Examine how institutions conduct everyday business |
| *Interventionist* | Assess and create interventions to improve practice |
| *Social Problems-Focused* | Make visible the local interactional conduct that underlies and produces social problems (e.g., conflict, power) |

In this section, I have described some of the main assumptions and features of conversation analytic research. The conceptual framework described above provides the language for describing and analyzing practices under investigation. Maynard and Clayman (2003) suggested that analysts typically do not (or should not) treat these concepts *a priori* constructs to find in the data. They argued that analysts should work to observe what social actors do, how they perform their actions, and describe the practices accordingly. I agree and further, take a skeptical stance about the treatment of these structures of conversation stable or separate from the researchers who have described them. As some scholars have emphasized, CA has relied on analysts' first being able to recognize practices to describe them in detail (e.g., Button & Sharrock, 2016). Analysts' initial sense-making, however, should not be considered a weakness. Instead, analysts' early interpretations can be conceived of as a key resource for examining and questioning how actions are built to be recognizable to both interactants and analysts. I now turn to a discussion of MCA, a distinct, yet related form of ethnomethodological research.

**Membership Categorization Analysis**

MCA is an ethnomethodological approach suited to study the local, situated production of culture, identities, and social realities. This approach grew out of Sacks' (1972a, 1972b) early work on membership categorization devices (MCDs) and how they manifested in social interaction and texts. Sacks (1972a) defined an MCD as a set of practices used for categorization along with rules for how to apply categories. In his seminal article about a phone call to a suicide prevention center, Sack (1972a) traced the membership categorization practices to describe how a caller could arrive at the conclusion that they had no one to turn to. Through this analysis, he described how the caller implied appropriate and inappropriate persons for providing help (e.g., family members versus doctors), the social rights and obligations assigned to individuals (e.g., obligation to help), and the relationships between categories (e.g., members of a family). In another article, Sacks (1972b) analyzed a child's story about a baby crying and their mother picking them up. He was interested in understanding how specific categories (e.g., baby and mother) and the related actions (e.g., mother picking the baby up) could be *heard as* naturally going together. Though he developed concepts to describe membership categorization practices (see Table 4), Schegloff (2007b) argued that Sacks' interest in categories was placed in the background as the founders of CA pursued the rigorous study of the fundamental practices that governed social interaction. Nonetheless, Sacks' early writings about categorization drew attention to how the naturalness of identities and associated actions were achieved, turn-by-turn, in social interaction.

Table 4

*Key Concepts of Membership Categorization Analysis*

| Concept | Definition |
| --- | --- |

| | |
|---|---|
| *Membership categories* | Classifications of types used to describe persons, places, or objects (e.g., 'scientist', 'student', 'white coat') |
| *Membership categorization devices* | A set of practices used for categorization with rules for how to apply categories |
| *Category-bound activities* | Activities that are associated with specific categories in (e.g., 'research' and 'scientists') |
| *Category-tied predicates* | Characteristics that are associated with specific categories (e.g., 'scientists' as 'detail-oriented') |
| *Standardized relational pairs* | Paired categories that have duties and moral obligations associated with the pairing (e.g., 'students-teacher', 'mentor-mentee') |
| *Duplicative organization* | Unit of categories that function as a group with distinct roles and obligations between each other (e.g., 'doctor', 'patient', 'nurse', 'intake clerk' as part of a 'healthcare team') |
| *Positioned categories* | Categories that have hierarchical relationship (e.g., 'professor', 'graduate teaching assistant', 'undergraduate student') |
| *Category-activity 'puzzles'* | People can do particular actions by putting together unexpected combinations (e.g., 'female scientists' |
| *Rules of application* | 1. *Economy rule*: A single category may be sufficient to describe a person |

| | |
|---|---|
| | 2. C*onsistency rule*: Two or more categories used together hear as part of the same family (e.g., ‘Black’ and ‘Latinx’ people heard together as members the minority groups) |
| *Categorization maxims* | These maxims are the case because of the rules of application<br>1. hearer’s maxim: categories that are duplicatively organized categories are heard as part of the same collection<br>2. Viewer’s maxim: when a category-bound activity is being done by a member of that category, it is seen that way (e.g., ‘scientist doing science’) |

Hester and Eglin (1997) claimed that, for reasons that were unknown, scholars in the United Kingdom (UK) and US diverged in their pursuit to develop MCA and CA, respectively. They argued MCA became more aligned with an ethnographic form of CA that was sensitive to participants’ orientations to “discourse identities”, settings, the topics that become relevant through social interaction (p. 7). Comparatively, Hester and Eglin claimed that American sociologists focused more on characterizing the features of sequential organization with less attention to categories and category-use. Similarly, Stokoe (2012a, 2012b), a scholar in the UK, argued that MCA suffered from limited methodological development and minimal guidance for conducting analyses. For example, she highlighted the fact that CA included a simplest systematics for conversational organization (i.e., practices for turn-taking, Sacks et al., 1974), yet MCA had not produced “categorial systematics” to describe how actors produce social types as *recognizable* categories (Stokoe, 2012b, p. 345). The primary focus on sequential organization in

CA in the US along with minimal methodological development of MCA has put categorial organization in limbo.

Schegloff (2007b), a CA scholar based in the US, disagreed with promoting MCA as a distinct sub-field of CA or as a separate endeavor. First, he expressed concern that categorial practice was not appropriately grounded in the sequential organization. Because of this, Schegloff (2007b) critiqued work on categorization for its lack of rigor and limited alignment with the core commitments of CA. For example, he characterized the work in MCA as interpretation (i.e., by analysts) rather than an analysis of actual conduct. Schegloff suggested that for MCA to establish its legitimacy, work on categorization would require the use of and familiarity with the analytic resources of CA. Related to this, he rejected the idea that MCA was a separate endeavor because it lacked novelty and included limited data that could demonstrate claims about categorization practices. Schegloff's (2007) criticisms of MCA can be read as an effort to encourage further development of the approach; alternatively, as a privileging of the methods and analytic focus of CA for analyzing interactional conduct. I discuss issues with this sort of framing in a critique below. While Schegloff (2007b) has offered critiques about the lack of attention to sequential organization, proponents of MCA have already acknowledged that categorial and sequential organization are entangled in practice (e.g., Hester & Francis, 1997; Stokoe, 2012b). Nonetheless, *how* these two forms of organization are entangled in social interaction is an area of research to be further developed and was the methodological inquiry for this study.

In the last 10 years, MCA has recently become a renewed interest within the EMCA community. The journal *Discourse Studies* published a special issue on MCA in 2012 that was developing the method and practice of MCA (Fitzgerald, 2012; Gardner, 2012; Stokoe, 2012a, 2012b; Whitehead, 2012). The book, *Advances in Membership Categorization*, was recently published by Fitzgerald and Housley (2015), two contemporary contributors to MCA. Stokoe (2012a) suggested that MCA shows promise for revisiting sociological concerns that were more evident in earlier versions of EMCA: "the analysis of constructed reality; of culture, identity and morality; of inference and meaning; of the analysis of interactional and textual materials, and its ethnomethodological spirit." (p. 279). She also argued that MCA can provide methods for ground so-called macro-level concerns (e.g., gender) in the categorial organization of everyday life. Given that this dissertation is focused on analyzing culture surrounding teaching in STEM disciplines, MCA offers useful resources for examining *culture-in-action* (Hester & Eglin, 1997) in the business of promoting change in instructional practices with STEM graduate students. This study provides an opportunity to develop collections of categorizing practices and juxtaposing them with sequential features of conduct. Thus, this study is an attempt to work through the strengths and weaknesses of both CA and MCA to contribute knowledge about categorial systematics.

**Onto-Epistemological Positions in Ethnomethodological Research**

In this section, I discuss epistemological and ontological (hereafter, onto-epistemological) positions for EMCA research. CA is said to comprise a coherent theory and method for studying social life (Stivers & Sidnell, 2013). Some scholars, however, have argued that a diversity of onto-epistemological positions espoused in CA and related research is evident in the empirical literature (e.g., Atkinson, 1988), published debates (e.g., Heritage, 2012; Lynch & MacBeth, 2016), and varied adoption of EM principles (e.g., Maynard & Clayman, 1991). CA has been described as a constructionist (e.g., O'Reilly & Kiyimba, 2015; Potter & Hepburn, 2008), specifically micro-social constructionist (e.g., Lester & O'Reilly, 2019). Scholars who adopt a constructionist stance have claimed that local interaction order, face-to-face-interaction, and situated action are sites for the construction of social realities and knowledge (Gubrium & Holstein, 2008; Lester & O'Reilly, 2019). CA has also been described as a form of ethnomethodological research (e.g., Heritage, 1984) and, therefore, distinct from constructionism (e.g., Hester & Francis, 2000). Scholars have claimed that EM does not espouse a general theory of knowledge (e.g., Lynch, 2008; Rawls, 2002). Further, it is argued that the description and analysis of reality is a phenomenon for social actors, not analysts (Hester & Francis, 1997). Hester and Francis (2000) admitted that because Garfinkel's (1967) early writings aligned with constructionism, some approaches to EMCA can be conceived of as a continuation of a constructionist agenda.

These diverse characterizations of EMCA align with the possibility that analysts espouse different onto-epistemological positions. Despite this variation, analysts share commitments to (1) demonstrating the production of social life based on how social actors make sense of each other and (2) a focus on interactional conduct as the appropriate site for systematic analysis of the local production of social order (Garfinkel, 1967; Sacks, 1992).

Table 5

*Summary of Possible Onto-Epistemological Positions in EMCA Research*

| Position | Features |
|---|---|
| *Positivistic Empiricism* | • Causal model of social inquiry (social physics)<br>• True knowledge based on observations of concrete phenomena<br>• Theoretical concepts and categories describe reality as it is<br>(Parsons, 1949) |

| | |
|---|---|
| *Particularistic Empiricism* | • Rejects causality<br>• Rejects *a priori* theory<br>• Objective knowledge is based on concrete phenomena<br>• Concrete phenomena can only be observed and described in temporal sequence<br>(Parsons, 1949) |
| *Intuitionist Empiricism* | • Rejects causality<br>• Rejects *a priori* theory<br>• Uses concepts to describe the uniqueness of individual phenomena<br>• Does not attempt to align with scientific aim to produce general body of knowledge<br>(Parsons, 1949) |
| *Instrumentalism* | • Rejects pure empiricism<br>• Theoretical concepts (e.g., turn-taking) treated as useful fictions that do not describe reality itself<br>(Parsons, 1949) |
| *Analytic Realism* | • Theoretical concepts grasp aspects of the real world<br>• Empirical observations are based on theory<br>• Concepts are analytical elements used to organize empirical data for the purpose of<br>(Parsons, 1949) |
| *Analytical Constructionism* | • Relativistic stance<br>• In favor of the use of concrete phenomena to produce knowledge<br>• Considers concepts, theories, phenomena, etc. constituted and constituting in research processes and products<br>• Explicit acknowledgement of the role of the constructing particular versions of reality that could be otherwise<br>(Pollner,1991, 1993; Potter & Hepburn, 2008) |

At the risk of oversimplification, I have offered six different onto-epistemological positions that could be conveyed in EMCA and related work in Table 5. To develop this, I revisited Parsons' (1949) methodological writings about so-called attitudes of social science inquiry since Garfinkel (1967) and Sacks (1992) studied his work as they were developing ethnomethodology and conversation analysis. Parsons argued that each of the attitudes was visible in how researchers treated of theory, concepts, and the relationship between what is studied and reality. While scholars might argue that a positivistic empiricist position, for example, is a misreading of the core of ideas of EMCA, I am suggesting that an analyst could also describe concepts (e.g., adjacency pairs) *as if* they exist independent of researcher description. A different analyst could emphasize the role of the researcher in constructing an account of social practice for an article. The emphasis on the participatory role of the researcher could align with analytical constructionism. I agree with Atkinson's (1988) suggestion that researchers should make their epistemological commitments explicit. This argument, therefore, is not about what positions particular scholars adopt or whether one is more right than the other. I am also hesitant to describe a reading of Sacks' (and his collaborators) work as a 'misreading'. Instead, and in keeping with ethnomethodological principles, I believe it is important to consider how the *uses* of theories, concepts, and terms in EMCA imply particular senses of reality and how knowledge should be produced.

I orient to EMCA as aligned with a social constructionist position. *The Social Construction of Reality* by Peter Berger and Thomas Luckmann (1966) was the first published book describing constructionism. Their work, which was also influenced by phenomenologist Alfred Schütz, articulated how social knowledge and conceptions of reality were constructed through social and cultural practices (e.g., language, socialization). Since its early conception, social constructionism has become increasingly diverse, drawing upon a range of philosophical perspectives (Best, 2008). Burr (2015) argued that there is no singular definition of social constructionism. Nevertheless, she suggested that proponents of social constructionism share four key commitments: (1) a critical stance toward taken-for-granted knowledge, (2) a conception of knowledge and understanding as situated within particular cultures and histories, (3) the notion that knowledge is maintained by social processes, and (4) the idea that knowledge and action are related. For the purpose of this discussion, I relate these constructionist commitments to EMCA.

First, EMCA can be considered ‘critical’ in the sense of questioning and attempting to make visible the taken-for-granted aspects of social life. Garfinkel (1967) and Garfinkel and Sacks (1986), for example, drew attention to how social scientists relied on taken-for-granted, common-sense knowledge about the social world to complete research tasks (e.g., coding). The purpose of EMCA research is to make these practices visible through detailed analyses of social interaction, thus critical questioning can be conceived of as a core practice of EMCA and aligned a social constructionist stance. Related to the second and third assumptions of social constructionism, Garfinkel (1967) theorized that social knowledge was produced and re-produced through social practices (i.e., language and actions). Burr (2015) argued that language provided a means for inheriting and passing on culture. Therefore, on the one hand, actors participate in language-used and inevitably contribute to the maintenance social knowledge and culture. On the other, the re-production of knowledge is necessarily situated within and shaped specific histories and cultures. Research MCA, in particular, to demonstrated the situated production and re-production of culture through language-use (Fitzgerald & Housley, 2015). Finally, knowledge and action are closely related in EMCA research. This aligns with Garfinkel’s (1967) assumption that actors behave in ways that imply what they know about the social world. Therefore, micro-focused social constructionism can be aligned with EMCA and related research approaches.

## A Constructive Critique of Ethnomethodological Approaches to Research

Despite reservations about some of the underlying principles of CA and MCA, I decided to draw upon these frameworks for this dissertation because I believed that a fine-grain study of language-use STEM graduate student teaching development could generate both methodological and practical insight about the education reform strategies. Instead of dismissing these reservations, I offer a critique as an attempt sit with methodological dissonance to consider the boundaries of what is acceptable within EMCA research. I believe that working through methodological dissonance – from within – can be a generative way to contribute to dialogue in the field.

Ethnomethodological research has been critiqued both within and outside of EMCA communities. Hammersley (2018), a regular critic of EMCA (and discursive psychology), recently published a book as an extended argument about his disagreements within ethnomethodological research. Hammersley has critiqued EMCA for foundationalism, CA's insistence on using naturally occurring data, for exaggerating indexicality, and the lack of critical treatment of the actor's point of view.  Other concerns that have been raised are unacknowledged epistemological diversity (e.g., Atkinson, 1988), formalism in CA (e.g., Lynch, 2008), and overestimated self-sufficiency of ethnomethodological research perspectives (e.g., Hammersley, 2003). Within the EMCA community, debates have ensued about normative practices for carrying out analysis. Examples of these include whether CA can or should be used for computer-mediated communication (e.g., Giles, Stommel, Paulus, Lester, & Reed, 2015), preferences for naturally-occurring or researcher-contrived data (e.g., Goodman & Speer, 2015), limited attention on sociological concerns (e.g., Stokoe, 2012a), and questions about whether CA can contribute to sociopolitical ends (e.g., Wowk, 2007). The critique I offer below is in light of these debates but focuses specifically on what I view as claims to local guarantees and sociopolitical neutrality.

***Local Guarantees***

I refer to the phrase 'local guarantees' to describe how that which is observed locally (e.g., moment-by-moment, face-to-face), using CA in particular, has given a privileged status for producing seemingly guaranteed knowledge about the social world. To develop this idea, I will highlight published debates between practitioners of CA and discursive psychology (Edwards & Potter, 1992), a more explicitly critical ethnomethodological approach to discourse analysis. Though I do not use discursive psychology for this study, my epistemological commitments are aligned with the form of discursive constructionism espoused in that approach (Potter & Hepburn, 2008). Additionally, as I have described above, the epistemological positions of CA and MCA research vary, thus this critique may point to tensions that may arise from varied uses of ethnomethodological principles. I will not attend to each of the concerns raised in the articles selected from the debate but focus on points related to the concern claims to local guarantees.

Emanuel Schegloff, one of the foundational contributors and, arguably, one of the gatekeepers of CA, has produced many works making sharp distinctions between CA and other language-in-use methodologies (e.g. Schegloff, 1997, 1998, 1999). In his seminal critique, Schegloff (1997) took to task critical discourse analysis on issues of context, relevance, and methods for grounding claims. He argued that analysts using critical approaches to discourses presume that contexts (e.g. sociopolitical) or categories (e.g. identities, race, etc.) were relevant and warranted in analyses. Schegloff did not take issues with the possibility of multiple characterizations of conduct or interaction but was concerned about the suggestion that all characterizations were "equally warranted, equally legitimate, entitled to identical uptake and weight" (p. 166). Researchers, he argued, should avoid theoretical imperialism or imposing theoretical notions of the social world on participants. Schegloff contrasted this form of imperialism with the idea that Columbus discovered America while indigenous peoples were already living there. He argued that what participants' oriented to in interactions, by contrast, had "prima facie validity" and was, therefore, constitutive of interactional realities and paralleled this with the status of indigenous peoples in so-called discoveries (p. 171). The object of study, he argued, should be what counts as relevant to participants as evidenced by what social actors treat as real within an interaction. Schegloff's main argument was that the appropriate grounds for warranting knowledge claims, along with the relevance of context and identities, should be grounded in participant orientations rather than the analysts' interpretations. Schegloff suggested that CA was one form of technical analysis that was suited to empirically demonstrate participant orientations. He argued that technical analysis, "may be a prerequisite to what aspires to the mantle of 'socially situated or critical analysis'" (p. 170). Schegloff compared this to critical analysis wherein *a priori* categories and social relations (e.g. race, gender, student-teacher, etc.) were presuppositions. He argued that because these categories were presumed in advance that the researchers would inevitably find them. By contrast, Schegloff suggested that because categories and contexts were not defined in advance for conversation analytic research, they might show up as outcomes or findings from technical analyses grounded in the data itself. As presented by Schegloff, CA is perhaps the only methodological approach that appropriately grounds claims. With this argument, Schegloff also applied the standards of technical analysis *as if* CA was the ruler by which all language-in-use methodologies should be measured by.

Schegloff's (1997) widely-cited article positioned CA as a primary methodological approach for the analysis of social interaction and, subsequently, positioned all other methodological approaches as secondary. If the notion of participant orientations was applied to the back and forth surrounding Schegloff's rebuke of critical approaches to discourse analysis, some of the responses from other ethnomethodological research approaches could be read as both concession and defense by how they adopt some of Schegloff's suggestions, while still defending their own. In a published debate, Wetherell (1998), one of the early developers of discursive psychology, advocated for a synthetic approach that draws upon the analytic tools of CA for "fine-grain analysis" (i.e., micro) and poststructuralism for "socialist and radical democratic political projects" (i.e., macro) for more "disciplined" or grounded analysis (p. 392). She made a distinction between Schegloff's technical analysis and scholarly analysis. For Wetherell, a scholarly analysis was less restrictive than CA by how it moves beyond sole attention to observable conduct, addresses both silences and absences in materials, and includes multiple influences (e.g., feminist theory, Foucault, etc.). She argued that Schegloff was "performing his own act of colonization in seeking to impose one narrow understanding of participant orientations" (p. 404).

For Schegloff, though, importing of influences beyond participant orientations was not necessary: "For CA, it is the members' world, the world of the particular members in a particular occasion, a world that is embodied and displayed in their conduct with one another, which is the grounds and the object of the entire enterprise, its sine qua non" (Schegloff, 1998, p. 416). Schegloff (1998) argued that readings in critical theory were not needed, but observations and noticings by social actors were. This view also had implications for the types of data that should be used for research, a debated topic within ethnomethodological research (e.g., (Potter & Hepburn, 2005; Goodman & Speer, 2015). Conversation analytic researchers have traditionally privileged naturally-occurring data (e.g., recording of activities that would exist without the researcher) over researcher-contrived data (e.g., interviews) that further remove the researchers' presence from influencing the conduct of social actors in their everyday settings. This privileging of naturally-occurring data is closely tied to a commitment to describing the underlying and universal structure of social life (Sidnell & Stivers, 2013). Seemingly at odds in this debate is whose perspective and what influences can be used to attribute what is understood in social interactions. The analytic frame of CA has been privileged compared to sociopolitical approaches to discourse analysis (e.g., critical discourse analysis) within this debate. Wetherell (1998) admitted that CA offered "discipline" for critical approaches to discourse analysis, but that the discipline "needs to be two ways" (p. 388). Given that some approaches to discourse analysis have become more aligned with CA in recent years, and perhaps not the other way around, whether this mutual disciplining takes place is questionable.

Speer (2001) offered another, seemingly conceding, response to Schegloff's work by offering a "more CA-aligned discursive approach" (p. 111). Unlike the synthetic approach introduced by Wetherell (1998), Speer argued that poststructuralism may not be necessary for sociopolitical engagement in discursive research. Following Edwards and Potter (1992), Speer rejected the distinction between 'micro' and 'macro'. She argued that 'macro' concerns (e.g., global patterns), which were typically not considered to be within the scope of CA, were observable and analyzable in local conduct. She demonstrated this possibility through an analysis of the constitution and negotiation of masculinity in interaction. From this, Speer argued: "we do not necessarily need to use Foucauldian poststructuralism, or make reference to features extrinsic to the interaction, to discover something fruitful about the political uses to which identity categories can be put, or to reach politically conclusions" (p. 127). On the one hand, Speer agreed with CA's technical orientation for analysis. On the other, she positioned this technical orientation as still as "fruitful" for sociopolitical concerns that Wetherell argued CA overlooks. Further, Speer positioned all research, whether from CA, DP, or feminists, as rhetorical, political, and engaged in political projects with (sometimes) different goals. Speer goes so far as to suggest that perhaps the CA-aligned approach she proposed may be "better than feminism at giving voice to its participants" in the way that it questions all knowledge claims and draws attention to the rhetorical and constructed nature of conduct (p. 128).

Schegloff's rebuke and the responses by Wetherell and Speer point to a concern I have related to the privileging of CA for local guarantees. First, Schegloff (1997) certainly positions CA or technical analysis as *the way*, and perhaps, the *only* way to ground claims in participant orientations. His positioning privileges CA's theory and method while ignoring the varied onto-epistemological positions, field-specific orientations, topics of study, and concerns of the wide range of methodological approaches that could be grouped in the category of critical approaches to discourse analysis (e.g. discursive psychology, critical discourse analysis, poststructural discourse analysis, etc.). This positioning also ignored other forms of inquiry, such as narrative theory, which have been very much interested in the analysis of participants' own theorizing about the social world (e.g. Riessman, 2008). Much like what sometimes happens in debates surrounding quality in qualitative research (Lester & O'Reilly, 2015), Schegloff inappropriately applied the theory and method as a gold standard for all others. The privileging of the CA is perhaps most notable in discursive psychology because of the shared ethnomethodological principles and the increased attention to the sequential organization as the approach to discourse analysis has become more aligned with CA over time (Potter, 2012). The dialogue about grounding claims, while still maintaining CA's privileged position, has provided important insights with Wetherell's (1998) suggestion that silences or absences as analytically important and Speer (2001), following Billig (1999), positioning CA as rhetorical and political.

### *Claims to Sociopolitical Neutrality*

Some ethnomethodological researchers have described their research program as inherently apolitical (e.g., Lynch, 2008; Schegloff, 1997). They have argued that the goal of ethnomethodological research is to describe reality as it appears to participants, rather than the analyst judgment about whether their conception of reality is 'right' or 'wrong' (Lynch, 2008). Further, Lynch (2008) argued that analysts do not take the side of participants on social issues to maintain an apolitical, neutral stance. However, Billig (1999) argued that CA is rhetorical and therefore political. Local guarantees, as a rhetorical move, can, therefore, be conceived of as a political act that is evidence in ethnomethodological writings.

Schegloff's (1997) argued that local interactional realities were objectively available based on the prima facie validity of participant orientations. There was no apparent skepticism or contingency from Schegloff regarding researcher observations of local interactional realities. This appears to fall in line with what Billig (1999) described as foundational and essentialist rhetoric. Similar foundational rhetoric can be observed with debates about whether researchers should analyze 'ordinary' versus 'institutional' talk to identify patterns that underlie the social interaction or use 'naturally-occurring' versus 'research-contrived' data for observing 'natural' conduct (Goodman & Speer, 2015; Heritage & Clayman, 2010; Potter & Hepburn, 2005). Ordinary conversation, for instance, has sometimes been positioned as a prerequisite for understanding the ways in which institutional settings shape interactions and, thus, seemingly positions ordinary conversation as foundational and not contingent (Billig, 1999; Sacks et al., 1974). As Hammersley (2018) has argued, however, it is unclear whether such foundational claims are necessary or warranted. Billing (1999) argued that CA assumes a theory of language and analytical concepts (e.g., ordinary, turn-taking) that do not necessarily rely on participant orientations. Conversation analysts use these specialized, foundational terms (i.e., turn-taking, ordinary) that are not explicitly linked to participants' uses, but they are discussed as if they exist *a priori*. I take this usage of theoretical or analytical terms and concepts to be similar to *a priori* presuppositions about oppressive social relations from feminist theory, for example. The notions of turn-taking and unequal social relations serve similar purposes: providing guiding frameworks for making sense of what is happening within data and in the social world. I agree with Schegloff (1997), though, that attending to what social actors treat as real and consequential is an important accountability practice for researchers to ground claims. However, as Billig (1999) argued, the rhetorical nature of CA is taken-for-granted when notions, such as *participant orientations*, *local*, *next-turn-proof*, and other theoretical or analytical concepts are positioned as objective rather than viewed as concepts used in service of arguments or to build cases for knowledge claims. The notion of local guarantees (contingent or not) appears to be an empiricist-aligned rhetorical move used in CA and related work to both legitimize and ground knowledge claims. What strikes me as odd, though, is that the skepticism of guarantees beyond local and contingent claims (e.g., Potter & Hepburn, 2008) is not readily transformable to the skepticism of guarantees beyond imaginative and speculative (e.g., Wetherell, 1998) claims as well. That is, the contingent local claims are positioned as generative, productive, and grounded (good), whereas anything thing beyond that (e.g., imaginative, speculative) is considered worthy of skepticism and not warranted (not good). It is my stance that observations of local conduct and actual events should also be positioned as worthy of skepticism.

As Schegloff (1997) argued, the truth of identities, categories, or contexts is not sufficient grounds for claims of relevance in talk-in-interactions. He claimed that since truth is not sufficient grounds for knowledge, participant orientations *should* be. It should not be lost on us that the practices suggested by CA and related work are normative, community-specific, and likely tentative as with any form of inquiry (Chalmers, 2013). Earlier writings in EM focused heavily on the ways in which researchers were involved in constituting particular versions of the world in the routine activities of doing research (e.g., Garfinkel, 1967; Garfinkel & Sacks, 1986; Pollner, 1987; Pollner, 1991). This involvement called for radical reflexivity (Pollner, 1991) wherein researchers acknowledge and make explicit the tension of being active participants in producing versions of social life through research. This positioning makes participant orientations a resource, rather than a guarantee, for research claims. The discussion of reflexivity is less evident in CA literature, yet important for the quality of the work (Lester & O'Reilly, 2019). Additionally, as Wetherell (1998) argued, silences, absences, and what is not oriented are fair game for analysis despite the difficultly of grounding them in actual conduct. I believe that speculative or imaginative musing supports researcher to analyze what is missing and, more importantly, to contribute to social change through language-use. This can be seen in more recent work in applied CA that focuses on generating evidence of the possibilities of language use (e.g., Conversation Analytic Role-Play Model, Stokoe, 2011; also see Peräkylä, 2011). As Stokoe (2012a) argued, Sacks' earlier work on membership categorization described how social change was made visible when category-use was changed. Noticing a change requires analysts (and actors) to see a new category use as an alternative to current use. This is a subtle, yet radical possibility for the applicability of ethnomethodological findings. Change in language-use, while still an ongoing production, seemingly requires speculation and imaginings about other possible was of being and new forms of social relations (i.e., a political end) not accounted for in the data itself; and change is likely not possible if diverse perspectives are not valued and researchers focus solely on local guarantees.

In summary, I have offered a critique of ethnomethodological research, particularly CA, for privileging the theories and methods for knowing about the social world. Additionally, I drew attention to the weakness of the claim that ethnomethodological research is apolitical or neutral. It is my stance that all modes of inquiry are informed by the political, economic, social concerns, and worldviews that make conducting academic research possible (Chalmers, 2013; O'Reilly & Kiyimba, 2015). Still, under the guise of ethnomethodological indifference, researchers in this field strive to ground knowledge claims in what social actors treat as real and consequential. This fact, however, does not make EMCA neutral or apolitical. As Rawls (2002) rightly argued:

> Ethnomethodology cannot be indifferent to political, ethical, or theoretical critique because that is essentially what it is. Ethnomethodology seeks to reveal the ways in which *taken for granted* social practices maintain the appearances of things. (p. 54, emphasis in original).

I now turn to a brief discussion of my theoretical orientation to CA and MCA for this study.

## Theoretical Commitments

"I ascribe a basic importance to the phenomenon of language." (Fanon, 1967, p. 1)

In this section, I describe aspects of my theoretical commitments for this study. These commitments were developed engagement with methodological readings, the theoretical and conceptual features of CA and MCA, and the critique offered in the previous section. As noted above, I engage with methodological dissonance in an effort to draw upon the benefits of using EMCA to generate knowledge about STEM graduate student teaching development while at the same time pushing back on points of tension. I begin with a discussion of my worldview. As O'Reilly and Kiyimba (2015) have argued, our worldviews are important for informing research interests, questions, and methodological approaches used. I do not believe it is possible to fully articulate my worldview. Rather, it is through conducting this study and writing that my view of the world will be made evident (Pollner, 1991). Then, I discuss my epistemological commitments, points of tension with the theory of conversation analytic research. I end this discussion with a brief discussion of how using CA and MCA for this study can generate substantive and methodological insights.

As a starting point, language is central to how I make sense of the world. By way of Fanon's (1967) seminal work, *Black Skin, White Mask*, I was drawn to phenomenological writings about the ways in which social actors implied the social world through language, as well as how language shaped how the social world was experienced. My interest in how to study language was developed through methodological readings from the field of discourse studies. The field of discourse studies encompasses a range of philosophical and theoretical perspectives, as well as distinct methods for studying how meaning and social life are produced in and through social practices (Angermuller, Maingueneau, & Wodak, 2014). Through engagement with ethnomethodological writings, particularly Garfinkel (1967), Pollner (1987), and Potter (1996), I developed a commitment to studying language-use in the mundane activities of everyday life. Through engagement with the methodological literature, I found that CA and MCA provided useful methods and concepts for describing language-use and characterizing the production of language-use.

As noted above, the onto-epistemological positions of scholars who conduct ethnomethodological research vary. I subscribe to micro-social constructionism (Burr, 2015; Gubrium & Holstein, 2008) with a commitment to producing knowledge about the social world through studies of the local, contingent production of social life. Specifically, through a micro-social constructionist perspective, I seek to examine what social actors produce as real and consequential through language-use. Some EM scholars have argued against making a distinction between ‘micro’ and ‘macro’ domains of social life because it minimizes the importance of local interactional activity (e.g., Hester & Eglin, 1997). Yet, ‘micro’ with social constructionism adds immediate specificity and recognizability to the narrow phenomena of interest of this particular stance. Thus, at the risk of re-producing arbitrary distinctions, I advocate for the use of ‘micro’ to describe the social constructionist stance adhered to for this study.

As a researcher, I consider myself an active participant, rather than a passive observer, in constructing an account of language-use (Potter & Hepburn, 2008). This position acknowledges that in order for researchers to study and describe that which is mutually intelligible to participants, it must first be recognizable to the analyst (Button & Sharrock, 2016; Pollner, 1991). I orient to the conceptual and analytic resources of CA and MCA (e.g., conversational structures, membership categorization) as useful theories for describing how actors work together at the level of talk-in-interaction to construct social life, as well as a strategy for producing an account of social practices. The accounts I produce will be partial and situated.

One of the goals of conversation analytic research is to describe the universal structures that underlie social interaction (Stivers & Sidnell, 2013). This is not a goal of my work, history has demonstrated the harm that can be done to groups of people by claiming singular ways of being (e.g., Fanon, 1967). Nevertheless, I orient to structures that appear to be universal as useful for points of comparison and remain agnostic about the possibility of generating claims about universal structures that underlie social interaction. An implication of this relates to generalizability in the sense of generating evidence from one group of social actors to make claims about what all humans can do with language. Instead, I adhere to what Peräkylä (2011) described as a commitment to generating accounts of the *possibilities of language-use* as an alternative form of generalizability. This means that I seek to generate claims about how social actors' use of language in local, situated conduct. These claims will be unique to that specific conduct, yet represent how language-use could unfold. Thus, I do not seek to guarantee that a similar form of language-use would proceed in the same way in different settings. However, I do suggest that these possibilities provide opportunities for learning and reimagining social life.

As it pertains to this dissertation, I consider STEM graduate student teaching development a site through which social actors participate in the local production of culture, identities, and social realities. As described in Chapter 2, scholars have advocated for teaching development as a key strategy for changing the culture and norms related to teaching in undergraduate STEM education. The research on this topic, however, primarily involves retrospective accounts and assessments of the effectiveness of teaching development practices. With this dissertation, I argue that if we are interested in learning how to change the culture of teaching in these fields, we should examine how cultural practices are produced and reproduced in STEM graduate student preparation, *in situ*. Therefore, this dissertation provides a novel methodological approach to study how, at the level of talk-in-interactions, STEM graduate student teaching preparation works to promote change toward the goal of undergraduate education reform.

**Chapter Summary**

In this chapter, I clarified my theoretical orientation to CA and MCA. I began with an introduction to EM and the principles that significantly influenced Sacks' (1972a, 1984, 1992) writings on CA and MCA. Next, I described CA and MCA, giving attention to the theoretical and conceptual resources that I will draw from for this study. Following this, I offered a critique of ethnomethodological research. Finally, I discussed my theoretical commitments and imaginings for substantive and methodological engagement for this study. In the next chapter, I provide a detailed description of the method used for this study.

# CHAPTER 4

# METHOD

The purpose of this study was to use a novel methodological approach to study teaching development for STEM graduate students and future faculty. In recent years, stakeholders have advocated for the incorporation of teaching development into graduate education as a key strategy for postsecondary STEM education reform (Austin et al., 2009; Kezar & Gehrke, 2015; NRC, 2012). This strategy involves both the preparation for teaching and efforts to shift the culture in STEM disciplines so that teaching is systemically positioned as a valued practice (Austin, 2010; Brownell & Tanner, 2012). Advocates of this reform strategy suggest that by incorporating teaching development into graduate education, future STEM faculty and educators will be aware of and potentially implement evidence-based teaching and, thereby, improve the quality of undergraduate STEM education (Pfund et al., 2009; Stowell et al., 2015). Scholars have also argued that STEM graduate student teaching development can promote shifts in disciplinary culture and attitudes wherein quality teaching is integral to the professional identities and practices in these fields (Austin et al., 2008; Tanner & Brownell, 2012). As such, efforts to produce knowledge about the preparation of STEM graduate students for teaching involves consideration of both how learning about evidence-based teaching is facilitated, as well as the disciplinary cultures that may shape these learning experiences.

For this study, I drew upon the analytic and conceptual resources of conversation analysis (CA) and membership categorization analysis (MCA) to investigate how participants in teaching development activities work to achieve the aim of improving postsecondary STEM education. This study took an alternative approach to current trends in the research on this topic that rely primarily on self-report and retrospective accounts to evaluate the impact of teaching development (see Chapter 2). Specifically, I pursued this study to examine how participants *do* teaching preparation through conversations about teaching and explore how cultures and identities are constructed and negotiated in these reform-focused activities. This research positioned language-use and social interaction as central practices for *doing* teaching development and considered them ‘studyable’ phenomena to make visible social and cultural practices that bolster and constrain these efforts. For this chapter, I first introduce the research questions for this study. Next, I briefly discuss the methodological approach. Finally, I describe the research procedures for conducting this study and practices for warranting claims.

## Research Questions

Research questions in qualitative research are typically open-ended, non-directional, and subject to change (Creswell, 2012). In ethnomethodological research, questions are generated through engagement with data (Lester & O'Reilly, 2019; Sacks, 1984). Sacks (1984) suggested that researchers be led by the data to decide what questions to ask, rather than presupposing what should be found by the types of questions we ask. Instead, he suggested that researchers “sit down with a piece of data, make a bunch of observations, and see where they will go (lecture 5, fall 1967)” (Sacks, 1984, p. 27). This data-driven approach is consistent with the ethnomethodological commitment to describing and inquiring about the social world on the terms of members of society rather than from the limits of the sociological imaginations of researchers alone. As Sacks’ (1984) noted, in attempts to study the social world, “however rich our imaginations are…we are constrained by reference to what an audience, an audience of professionals, can accept as reasonable” (p. 25). Therefore, in alignment with Sacks’ recommendations, I began the study by searching the data and making general observations. In the early stages of data analysis, I found that disagreement was a common social activity that occurred in each group included in the study. Disagreement is an instance wherein one speaker expresses a different view or perspective than that of another speaker (Sacks, 1987; Sifianou, 2012). The broad question that framed this dissertation was: *How do social actors do disagreement in STEM graduate student teaching development activities that are designed to promote instructional change in higher education?*

Four specific questions were developed to ground both the substantive and methodological foci of this dissertation. The substantive focus of this research was to illuminate the discursive practices involved in doing teaching development in STEM disciplines. By studying STEM graduate teaching development *in situ*, rather than from reported accounts, it was possible to learn how participants in these activities work together, moment-by-moment, toward the goal of instructional change in STEM. Methodologically, the research questions were aligned with my goal contribute to the efforts to use MCA to characterize the systematics of categorial organization in the same way that CA has been used to generate detailed accounts of the sequential organization of interactions in everyday and institutional settings (Heritage & Clayman, 2010; Sacks, 1992; Stokoe, 2012a, 2012b). Hester and Eglin (1997) argued that the sequential and categorial aspects of social interactions inform each other and are "separable only for the purposes of analysis" (p. 3). As Stokoe (2012a) noted, however, conversation analytic studies rarely attend to both sequential and categorial organizations. Thus, with this study, I sought to explore the methodological insights that could be gained by combining applied CA and MCA for a detailed analysis of the sequential and categorial organizations of disagreements within the institutional context of STEM graduate student teaching development meetings. The finalized research questions were:

1. What are the characteristics of the interactional contexts that participants co-constructed and oriented in meetings for multidisciplinary STEM, discipline-specific, and identity-based approaches to teaching development for graduate students and future faculty?
2. How are disagreement sequences produced and managed in teaching development meetings for STEM graduate students and future faculty?
3. How are categories used in the production and management of disagreement sequences in these meetings?
4. How and why did individual cases deviate – sequentially and categorially – from the general patterns of disagreement in STEM graduate student teaching development meetings?

**Methodological Approach**

A detailed discussion of the theory and method of applied CA and MCA was presented in Chapter 3. In this section, I provide a summary of the methodological approach and influences for this study. In this work, I subscribed to an ethnomethodological commitment to attend to the sense-making practices and local production of social realities between social actors (Garfinkel, 1967). The production and concreteness of social realities are unavoidably produced through language-use and social interaction (Garfinkel & Sacks, 1986; Sacks, 1992). Specifically, I took a micro-social constructionist stance, which examines the taken-for-granted ways in which social realities are produced as given and stable through microinteractional sites of construction (Hubrium & Gubrium, 2008; Lester & O'Reilly, 2019). One goal aligned with this epistemological position is to generate detailed accounts of how language-use produces particular social worlds. While some researchers resist the idea of a general theory of knowledge for ethnomethodologically-aligned inquiry (e.g., Garfinkel, 1967; Lynch, 2008), others have argued that ethnomethodological principles and micro-focused constructionisms share a concern for the local, situated, and taken-for-granted processes that produce social realities (Lester & O'Reilly, 2019; Potter & Hepburn, 2008). Thus, I worked across these tensions to produce an account of the local production of social realities constructed through disagreements in STEM graduate student teaching development meetings.

To answer the research questions, I drew upon the analytical and conceptual resources of applied CA and MCA. CA is an ethnomethodological approach that investigates the orderliness of language-use in social interaction and examines how social actors work together to produce intersubjective realities (Schegloff, 1997). CA offered key analytic concepts and an empirical literature base to characterize how actors construct meaning and social actions at the level of talk-in-interaction. MCA is a related ethnomethodological approach developed from Sacks' (1972a, 1972b) early interest in social categories. This approach attends to how culture, identities, and social worlds are implicated in talk and text. Through language-use, members of society produce particular types of persons, their associated characteristics, and display their presumably shared knowledge about social worlds (Fitzgerald & Housley, 2015; Stokoe, 2012a). MCA, thus, offered a micro-focused analytical framework to examine how social actors produce, rely on, and analyze versions of the social world within social interaction. Together, CA and MCA provided useful resources to explain how participants worked together to *do* disagreement within teaching development activities for STEM graduate students and simultaneously examine how culture, identities, and social realities were implicated in these interactions.

Hester and Francis (2000) argued that each ethnomethodological study is unique to the phenomenon under investigation.  They suggested that there can be "no universal method" for research due to an ethnomethodological commitment to examining the contingent and varied ways in which members of society *produce* society through language-use and interaction (p. 5). In ethnomethodological studies, the production process itself is the phenomenon under investigation. Members of society do this production in varied ways and, therefore, phenomena will be equally diverse. Following Garfinkel (1968), Hester and Francis (2001) argued that "'method' cannot be separate from and independent of the objects of one's investigation" (p. 5). I took this to mean that each phenomenon is unique and therefore the method must be designed according to the distinctive character of the data itself. Aside from a preference for audio and video-recordings for datasets, researchers who conduct ethnomethodologically-aligned studies do not adhere to prescribed, step-by-step procedures for carrying out analyses (Maynard & Clayman, 1991; Seedhouse, 2004). Instead, researchers advocate for coherence between ethnomethodological principles and chosen research procedures (Benwell & Stokoe, 2016; O'Reilly & Kiyimba, 2015). Given the relationship between data and method for ethnomethodologically-aligned studies, the method described here is fitted to the study of disagreement in STEM graduate student teaching development meetings within three distinctive interactional contexts. Below I briefly discuss CA and MCA (see Chapter 3 for more details), as well as the research procedures of this study.

***Applied Conversation Analysis***

CA is used to analyze language-use in social interactions in both everyday and institutional settings. Based on empirical studies of conversation in various settings, Sacks, Schegloff, and Jefferson (1974) theorized that turn-taking was a central organization in conversation. They observed that participants in conversations produce a variety of actions through turns of talk, have methods to allocate turns, and produce their turns sequentially related to other turns. The authors also noted that while the types of turn-taking practices (e.g., interviews, meetings) vary, everyday conversations form the basis for all other practices. In other words, they argued that the turn-taking system of everyday conversation is the foundation for all other forms of speech-exchange. This foundation, they claimed, is adapted for other forms of speech-exchange to carry out business in institutional settings.

In this work, I took an agnostic position as to whether everyday conversation is foundational to other forms of speech-exchange. I instead oriented to the distinct forms of language-use and social interaction, whether institutional or everyday settings, as useful for analytical points of comparison. This position aligns with a micro-social constructionist commitment to data-driven description at the level of language-use in social interaction as congruent CA (and MCA), minus foundationalist claims about conversational structures (see Chapter 3). Therefore, with this approach, I considered the conversational structures proposed by Sacks, Schegloff, and Jefferson (1974) to be useful analytical resources to compare language-use in different settings for STEM graduate student and future faculty teaching development.

The distinction, albeit blurred, between structures in everyday conversation compared to other speech-exchange systems (e.g., debates, interviews, institutional talk) is what separates traditional and applied CA. Whereas traditional CA is primarily concerned with describing generalizable structures of conversational practice, applied CA considers the context-specific ways in which turns of talk are used to produce social actions in institutional settings (Heritage & Clayman, 2010; Maynard & Clayman, 1991). It is argued that language-use within institutional settings is situated within particular institutional goals, prescribed identities, epistemic rights, and context-specific norms that potentially shape how interactants conduct their business (Maynard & Clayman, 2003). CA studies that describe language-use in everyday settings can be useful points of comparison to make visible the unique, context-shaped practices carried out in institutional settings. Thus, attending to the conversational structures of language-use in institutional settings and comparing these with findings from traditional CA studies supported the characterization of the context-specific ways in which actors performed disagreement within the distinctive institutional contexts of STEM graduate student teaching development groups.

Of the six types of applied CA outlined by Antaki (2011) and discussed in Chapter 3, this study aligns most with institutional applied CA. Researchers who conduct institutional applied CA studies are generally interested in making visible how the business of institutions is carried out to achieve their goals. An ethnomethodological study of the business of an educational institution, for example, might involve examining how "doing education" is produced *as* educational by participants (i.e., teachers and students) in classrooms to achieve the institutional goal of learning (Hester & Francis, 2000). For this study, I sought to illuminate how STEM graduate students and institutional leaders carried out the business of *doing* teaching development for the goal of education reform and the role of disagreement for doing so. This analysis addressed Research Questions 1, 2, and 4. By attending the institutionality of interaction, this study highlighted how identities, knowledge rights, and norms shaped language-use and social interactions involved in doing of teaching development. Specifically, by examining the disagreements in this context, my goal was to generate knowledge about how resistances, skepticism, and critical questions were raised while learning about evidence-based educational practices. Given that previous studies of STEM graduate student teaching development have not closely examined social interactions and disagreements within this context, this analysis was undertaken to generate new insights based on practice, *in situ*.

### *Membership Categorization Analysis*

The work of STEM graduate student development is equally about preparation for teaching as it is about shifting the culture surrounding teaching in these disciplines (Kezar & Gerhke, 2015; Tanner & Brownell, 2012). These institutional efforts can be conceived of as attempts to broaden what it means to be scientists and to normalize quality teaching as a practice of scientists, for example. MCA is useful for examining how members of society describe social realities, identities, and cultures, as well as display their understanding of the social world works (Stokoe, 2012a; Fitzgerald & Housley, 2015). MCA was employed in this study to examine how participants in STEM graduate student teaching development constructed and negotiated social realities, identities, and culture in courses of disagreement. For this analysis, I used seven MCA concepts to illuminate and characterize the categorial organizations of disagreements (Jayyusi, 1984; Sacks, 1972; Schegloff, 2007; Stokoe, 2012a):

- **Membership categorization device**: one more categories along with specific rules of application and their features.
- **Category-bound activities**: Activities that are associated with specific categories-in-use (e.g., scientists conduct research).
- **Category-tied predicates**: Characteristics that are associated with specific categories (e.g., scientists as ‘detail-oriented’).
- **Standardized relational pairs**: Paired categories that have duties and moral obligations associated with the pairing (e.g., students-professor, mentor-mentee).
- **Duplicative organization**: Unit of categories that function as a group with distinct roles and obligations between each other (e.g., mentor, lab, research group).

- **Positioned categories**: Categories that have hierarchical relationship (e.g., professor, undergraduate student).
- **Category-activity puzzles**: A concept to describe how social actors produce unexpected combinations (e.g., smiling scientists) to perform particular social actions (e.g., humor).

Importantly, I oriented to these terms as sensitizing concepts (Blumer, 1954) rather than pre-given structures that determine categorial organization in social interaction (Hester & Eglin, 1997; Jayyusi, 1984). This analytical perspective addressed Research Questions 3 and 4.

## Research Procedures

While there is no singular approach to describe ethnomethodological inquiry, analysts who conduct CA and MCA do subscribe to some shared research procedures. The research procedures described in this section drew upon Lester and O'Reilly's (2019) guidance for CA studies in institutional settings, Potter's (2012) research practices for discourse analysis, Seedhouse's (2004) procedures for applied CA studies, and Stokoe's (2012a) recommendations for MCA studies. Below I describe the procedures for identifying and accessing the research sites, data collection and sources, analytical practices, warranting claims, ethical considerations, and research quality.

### *Identifying and Accessing Research Sites*

The research sites for this study were groups that facilitated naturally-occurring teaching development activities for STEM graduate students and future faculty. Naturally-occurring activities are interactional events that ordinarily occur in social settings, are organized by participants themselves, and are carried out whether or not research is conducted (Mondada, 2013). The most common types of teaching development activities are pre-semester orientations, short-term workshops, and teaching assistant meetings (Connolly et al., 2016; Schussler et al., 2014). Short-term efforts have been considered ineffective for changing instructional practices (Henderson et al., 2011) and insufficient to develop core competencies for future teaching-related roles (Connolly et al., 2016). Long-term face-to-face and online teaching development learning communities have become key features of local and national initiatives for STEM graduate students and future faculty (Connolly et al., 2016; Laursen, 2019). The Center for the Integration of Research, Teaching, and Learning, for instance, advocates for the use of local and national learning communities to build capacity for change and contribute to STEM higher education reform (CIRTL, 2019). Relatedly, discipline-based (e.g., chemistry) teaching development groups are often coordinated through departments or campus teaching and learning centers to create long-term communities of practice for institution-specific instructional change efforts (Marbach-Ad et al., 2014; Laursen, 2019). These teaching development activities generally last at least one term (e.g., semester, quarter), often encourage on reflection on practice, may offer feedback on teaching, and provide venues for ongoing mentorship and social support from peers and faculty (Baiduc et al., 2016; Cox, 2004). Since one of the goals of this dissertation was to closely examine what the research indicates *should* work well to promote instructional change, only sites with long-term teaching development activities were recruited for this study.

The sites that were considered for this study were teaching development groups at institutions affiliated with a national network (NextSTEM, pseudonym) of 40 research-intensive universities that implement online and face-to-face programs for STEM graduate student and future faculty development. Two sites were STEM graduate student teaching and professional development groups that I co-facilitated from 2017 to 2019. In these cases, I held legitimate membership and was involved in the design, facilitation, and implementation of naturally-occurring teaching development activities. Both of these groups were identity-based affinity groups for graduate-level women of color (WoC) and women (WOM) in STEM disciplines. After data collection and analysis, I decided to exclude the WoC group from the current study, in part, because the conversations were not as closely-aligned with teaching development as I initially anticipated (see the Ethical Considerations subsection below for further discussion). Additional groups were identified in collaboration with the national network leaders. In December 2018, I contacted the NextSTEM network leaders to discuss the possibility of collecting data with affiliate institutions. Following this, I met virtually with a network contact three times to discuss the study and sent the network leadership team a research synopsis for review. The network contact then provided profiles for each affiliated institution (e.g., events per year, types of activities, etc.), as well as a shorter list of specific institutions they recommended to recruit for the study. Of the 40 institutions available, I selected 10 institutions that had at least one teaching development activity per term and those with institutional leaders with whom I already had positive relationships and rapport. The network contact then offered to send an email introduction to institutional leaders for universities I selected.

Upon approval from both the Institutional Review Board (IRB) and the NextSTEM network leaders, the network contact sent email introductions to the institutional leaders in early July 2019 (Appendix A). I followed up with direct emails to institutional leaders to request help with identifying teaching development facilitators who led groups for STEM graduate students and future faculty. This email included a form for teaching development facilitators to complete to express interest in participating in the study (Appendix B). Three facilitators completed the interest form within the two-week recruitment period in July 2019. Four additional contacts responded and either declined participation or indicated that they were not leading a group during the dissertation data collection period. Once interest forms were completed, I held one-on-one virtual informational meetings with teaching development facilitators in July and August 2019. The purpose of these meetings was to discuss the study purpose, logistics, data collection procedures, and feasibility for participation. Following this, each facilitator was contacted at the beginning of the academic year to confirm the intent to participate and to identify meeting dates that would be suitable for recording. The required forms and study information for research through external institutions were submitted to the IRB of each participating institution before formal recruitment with all group members. The final three sites were selected once internal and external IRB approved the study and after facilitators confirmed intent to participate. Formal consent was obtained for group members at each site following these initial recruitment activities.

**Consent Procedures.** The IRB approved informed consent to be obtained by me directly or indirectly through a group facilitator. Each group in the study was offered the option for me to attend the first five minutes of their first group meeting to explain the study and consent procedures. One group invited me to join their meeting by videoconference to discuss the study purpose, data collection, consent procedures, and address questions. Another group asked me not to attend their meeting and instead requested a PowerPoint slide (Appendix C) with a general overview of the study that facilitators could share with a group in addition to the detailed study information sheet approved by IRB. All were participants were informed that only groups with 100% consent would be considered for full participation in the study. Facilitators were given the option to either use either electronic or paper forms to obtain consent. Facilitators collected, scanned, and emailed paper consent forms to me. For electronic consent forms, facilitators emailed a link to Qualtrics form to group members on my behalf. I confirmed receipt of electronic consent forms using an email list provided by a facilitator. For the group that I facilitated, informed consent was obtained for a previous IRB-approved study and included video recordings of learning community meetings held from 2017 to 2019. Extant data from this group were included in this dissertation study. Facilitators who collected data on my behalf and were compensated at a rate of $25 per recording for the work required to collect and upload data files. Payments were sent directly to facilitators through their preferred mobile payment service application (e.g., CashApp, Venmo). Compensation was not provided for the remaining group members.

### *Research Settings and Participants*

The final groups included in the study facilitated three types of teaching development: (1) an identity-based learning community, (2) a discipline-specific journal club and seminar, and (3) a multidisciplinary learning community. The descriptions of research settings and participants provided below are based on information provided by facilitators during the informational meetings in July and August 2019. Pseudonyms were assigned to groups and individual members.

**Affinity Group for Graduate-Level Women in STEM**. The Affinity Group for Graduate-Level Women in STEM (WOM) group was a year-long, peer-led teaching and professional development learning community for individuals interested in strengthening their teaching, STEM communication, mentoring, and outreach skills. This learning community was co-facilitated by two advanced science education doctoral students and included up to 15 peer members from various STEM disciplines (Table 6). I co-facilitated and developed the curriculum for this group from 2017 to 2019.

Table 6

*WOM Learning Community Participants and Areas of Study*

| Participant | Year | Area of Study |
|---|---|---|
| Kimberly | 3rd | Anatomy Education |
| Riley | 3rd | Animal Behavior |
| Ariana | 4th | Bioanthropology |
| Melissa | 4th | Biochemistry |
| Salina | 3rd | Biology |
| Remi | 2nd | Biology |
| Helen | 4th | Chemistry |
| Macy | 4th | Chemistry |
| Etienne | 3rd | Environmental Science |
| Amber | 4th | Health Behavior and Epidemiology |
| Michal | 4th | Neuroscience |
| Angela | 4th | Pharmacology |
| Jenny, Co-Facilitator | 3rd | Science Education |
| Francesca, Co-Facilitator | 5th | Science Education and Inquiry Methodology |
| Yasmeen | 3rd | Statistics and Sociology |

The goals of the WOM group were to (1) cultivate a peer support network among graduate women to support retention in STEM, (2) strengthen and refine evidence-based educational practices (e.g., teaching, mentoring), and (3) enhance self-efficacy through leadership and transdisciplinary skills development. To pursue these goals, the group held monthly, 60-minute, face-to-face meetings to cover two semester-long curricular modules in the fall and spring semesters, respectively: (1) *Foundations of Teaching, Mentoring, and Learning* and (2) *STEM Communication and Outreach*. Each meeting included structured community-building activities (e.g., group reflection and support), discussions of the scholarship of teaching and learning (Hutchings & Shulman, 1999), STEM education research, and evidence-based practices related to the modules. In addition to monthly meetings, group members were required to attend at least two teaching and professional development activities offered through the NextSTEM network or the campus teaching and learning center. Each participant was also expected to design and implement an evidence-based classroom or outreach activity and share the results of this work at a year-end symposium.

**Biomedical Education Journal Club Seminar.** The Biomedical Education Journal Club Seminar (BME) was part of broader institutional and departmental efforts to prepare future biomedical faculty through a scientist-educator doctoral program (e.g., Bader et al., 2010). In this program, students develop substantive expertise in both biomedical sciences and pedagogy to prepare for teaching key courses required for medical and healthcare students (e.g., physicians, dentists, nurses), such as anatomy, histology, and embryology. Doctoral students in this program complete five years of biomedical science courses in the School of Medicine and a doctoral minor in education. Additionally, students are required to participate in a journal club seminar, supervised teaching for biomedical science courses, supervised research, and monthly departmental seminars.

The BME teaching development activity examined for this study was the journal club seminar. The purpose of the journal club was to read and discuss seminal and recent literature about evidence-based educational practice, foster a discipline-specific community of practice, and strengthen biomedical science education. The journal club was a semester-long (i.e., 16 weeks) credit-bearing course with 60-minute weekly meetings between faculty and graduate students at two research-intensive institutions: Middletown University and Downtown University. The universities held both separate and combined face-to-face group meetings; the combined meetings were coordinated through synchronous videoconferencing. Separate group meetings were held every week and the combined meetings occurred monthly. Some meetings were also set aside for graduate students only. Each week, a member of the group, primarily a graduate student, was designated as the discussion leader. Discussion leaders were responsible for selecting weekly articles for group members to read and discuss, and also for guiding conversations during the meeting. Up to 14 doctoral students and five faculty participated in the journal club.

**STEM University Evidence-Based Teaching Learning Community.** The STEM University Learning Community (STEMU) was part of the NextSTEM network's effort to create a standardized, nationally-recognized teaching development activities for future faculty in STEM disciplines. To do this, NextSTEM offers introductory and advanced massive open online courses (MOOCs) about evidence-based educational practices (e.g., teaching, mentoring). These courses were designed for audiences with minimal familiarity or experience education theories and research, and provide opportunities to practice specific educational tasks (e.g., lesson design and analysis). To supplement MOOCs, the network encourages affiliated institutions to lead local teaching development activities, such as learning communities or journal clubs, to situate instructional change efforts within their specific institutional, departmental, and disciplinary contexts.

STEMU was a local future faculty learning community that supplemented meetings with a NextSTEM MOOC about evidence-based teaching. The group was facilitated by a faculty member from the campus teaching and learning center and an advanced biology doctoral student who had extensive training in college-level pedagogy. In the Fall 2019 term, STEMU held 10 weekly, face-to-face meetings that lasted 90 minutes. Each meeting covered a topic related to research-based educational practices, such as inquiry-based learning, student-centered teaching, active learning strategies, and practices to support diversity, equity, and inclusivity in STEM learning environments. Similar to the WOM group, participants were required to complete a curriculum design or inquiry project (e.g., design a lesson plan, action research) and share the results of this work at the end of the term. Students were also given the option to earn academic course credits for their participation in the learning community. This group included 18 graduate- and 13 postdoctoral-level scholars from various STEM and social and behavioral science disciplines (Table 7).

Table 7

*STEMU Learning Community Participants by Discipline*

| Area of Study | n |
|---|---|
| Life Sciences | 20 |
| Social Sciences | 4 |
| Engineering | 2 |
| Mathematics and Computer Sciences | 2 |
| Earth Sciences | 2 |
| Physical Sciences | 1 |
| Total | 31 |

### *Data Collection and Sources*

The data sources for this study were video and audio recordings of face-to-face teaching development meetings that took place between Fall 2017 and Fall 2019. Potter (2012) recommended that researchers ask participants to collect the data themselves to minimize the effect of the researcher and to allow participants to deal with ethical issues that may arise on their terms. Throughout the study, I sought to minimize the workload required for research participants and invited their input about the practical and ethical considerations related to data collection. During the recruitment and consent processes, participants were asked to collect recordings of least three meetings and were given the option of either (1) collecting data on my behalf or (2) for me to set up audio- or video-recording equipment at the beginning of their meetings for data collection. At that time, I encouraged participants to stop recordings at will when sensitive topics were being discussed or if ethical concerns arose during meetings. Facilitators also selected all of the dates for data collection and were given the choice to collect either audio or video-recordings based on preference and the recording equipment that was available to them.

Data were collected from 24 meetings that occurred in the four groups recruited for the study. The dataset comprised 17 hours and 12 minutes of video, 11 hours and 16 minutes of audio recordings, for a total of 28 hours and 28 minutes of recorded teaching development meetings. The STEMU group opted to collect video recordings on my behalf. The facilitators sought to increase the anonymity of student participants and decided to collect recordings with the video camera focused on facilitators. The BME group asked me to join their meetings by videoconference to collect recordings because it was the least disruptive to their regular practice. The data from the WOM group was from an extant dataset that I collected for a separate study. As noted above, I decided to exclude the WoC group from the study after data collection and analysis. The final dataset analyzed for this study comprised 18 hours and 24 minutes of recordings from 15 meetings that took place in the WOM, BME, and STEMU groups (Table 8).

Table 8

*Summary of Data Collected by Group*

| Group | Collection Period | Data Type | Meetings | Hours |
|---|---|---|---|---|
| WOM | Fall 2017-Spring 2018 | 1 Audio, 3 Video | 4 | 04:24 |
| BME | Fall 2019 | Video | 5 | 04:20 |
| STEMU | Fall 2019 | Video | 6 | 09:33 |
| | | *Total* | *15* | *18:24* |

## Analytical Practices

The analytical procedures for this study were honed through an iterative process and reflexive engagement with the data (Lester & O'Reilly, 2019). The key practices for analysis were reflexivity, data management, unmotivated looking, coding, building collections, transcription, warranting claims and research quality, and ethical considerations.

### ***Researcher Reflexivity***

Reflexivity is an analytical act closely tied to my theoretical orientation described in Chapter 3. The term reflexivity is variably defined in the research literature. England (1994), a feminist researcher, described reflexivity as a "…self-critical sympathetic introspection and the self-conscious analytical scrutiny of the self as researcher" (p. 82). Hertz (1997), an ethnographer, suggested that reflexivity means to '…to have an ongoing conversation about experiences while simultaneously living in the moment" (p. viii). I subscribe to Macbeth's (2001) definition of reflexivity as a "deconstructive exercise for locating the intersections of author, other, text, and world, and for penetrating the representational exercise itself" (p. 35). This definition is resonant with the ways in which ethnomethodologically-aligned researchers draw attention to the constructive and constitutive processes both researchers and members of society use to describe the social world (Pollner, 1991; Potter & Hepburn, 2008). In other words, in the process of doing research, I will display my understanding of the social world and engage in practices that constitute particular versions of social realities.

Reflexivity for this dissertation involved regular consideration of my experience, perspectives, research commitments, understanding phenomena, and decision-making practices that shaped the research process (Lester and O'Reilly, 2019). To do this, I participated in a monthly critical friend group with science education researchers from June to December 2019. During these meetings, I shared data transcripts and received feedback about my ideas and interpretations of the data. I also had three one-on-one meetings with my methodology advisor (Jessica) to discuss what I was noticing in the data. Following these meetings, I wrote notes in a paper journal to chronicle the shifts in analytical focus and interpretations throughout the research process. Each of these practices pushed me to consider how my background, training, experiences, and teaching development practice shaped my interpretations of the data.

***Data Management***

As data were collected, I stored them by source type using an external hard drive specifically for dissertation files. Verbatim transcription was completed for each data file using Otter.ai, an artificial intelligence transcription service, to reduce the time spent on this task (Lester & O'Reilly, 2019). Once verbatim transcription was complete, transcripts were assigned unique identifiers. The digital tools that were used to manage data included ATLAS.ti, a computer-assisted qualitative data analysis software package, and Google Drive for project management, analysis, and document research decisions for an audit trail (Paulus, Lester, & Dempster, 2014).

### *Transcription*

Transcription is a selective analytical process that involves both decisions about what and how to transcribe from recordings that vary by research approach (Hammersley, 2010; Ochs, 1979). In EMCA research, transcription is considered a core analytical act that is central to making sense of how social actors perform actions with words (Hepburn & Bolden, 2017). Gail Jefferson's (2004) transcription conventions are used across CA and related research and were designed to be sensitive to the varied resources interactants use to perform social actions. Jeffersonian transcription attends what we hear interactants say, how they utterances are delivered (e.g., pitch, pace), timing, and visible conduct (e.g., gesture, gaze) (Hepburn & Bolden, 2017). This is in contrast to gisted transcripts or verbatim transcripts commonly used in research that modify what is said or attend only to words that are said (Paulus, Lester & Dempster, 2014). EMCA research treats the micro-feature of interactions, such as breaths, laughter, and prosodic elements of language as important aspects of producing social action. It is important to note that while transcription core EMCA practice, it is a supplement to original recordings (Hepburn & Bolden, 2017; Schegloff, 2007a). Throughout the analysis process, I privileged engagement with audio and video files and used Jeffersonian transcription selectively to characterize the linguistic, prosodic, and grammatical specificity of disagreements. The list of transcript conventions used in this study is provided in Appendix D.

In addition to Jeffersonian transcription, I created gisted transcriptions of meeting structure and interactions for each group (Figure 2).

Figure 2

*Example Gisted Structure and Interaction Transcription for a STEMU Meeting for Excerpt #5*

| Video | Activity | Time | Blocks |
|---|---|---|---|
| **23Oct2019STEMUvideo** | **Note: 6 DISAGREEMENTS** | | |
| | Transition: "I'll have X take this one" | 0:10:44 | IRE Activity |
| Introduce alternative approach to teaching | Facilitator B - introduces a contrast traditional versus non-traditional (student-centered) teaching | 0:10:45 | IRE Activity |
| | Facilitator B: Does that make sense? | 0:13:24 | IRE Activity |
| **INVITATION TO RESPOND WITH QUESTION** | **Faciliator B: Any questions about that?** | 0:13:25 | IRE Activity |
| **CRITICAL QUESTION** | **Individual response: I don't know if this is a nice question?** | **0:13:20** | **critical point** |
| | Laughter | | **critical point** |
| | Individual Critical question | 0:14:32 | **critical point** |
| **LEAD RESPONDS** | Faciltator B: Great question and response | 0:14:35 | **critical point** |
| | Does that make sense? | 0:15:53 | **critical point** |
| | Facilitator continues | 0:15:53 | **critical point** |
| | Does that make sense? | 0:16:30 | **critical point** |
| | Does that answer your question? | | **critical point** |
| | Individual: I think I'm stuck | 0:16:33 | **critical point** |

As shown in Figure 2, these transcripts were used to track turn-taking, gisted talk (e.g., "Does that make sense?"), timing, and blocks of activities (e.g., Initiation-Response-Evaluation) within each meeting. These interactional features were transcribed for the entirety of the meeting so that I could make sense of the interactional structure(s) of the meeting as a unit. Given that interactions in institutional settings are often constrained by prescribed meeting structures and interactional procedures (Lester & O'Reilly, 2019; Robinson, 2013), tracking the aforementioned interactional features were helpful for making sense of the institutionality of the meeting interactions. Ultimately, these transcripts were generated so that I could gain familiarity with the data, to support unmotivated looking, and to highlight portions of the data to consider for further analysis.

### ***Unmotivated Looking and Noticing***

A common practice in EMCA research is to begin the analysis with unmotivated looking. Sacks (1984) recommended that researchers be open to what language does and what people can do with language when making observations. From an unmotivated stance, researchers set aside, as best they can, their research agendas, theories, and ideas about what *should* happen to make observations about what *is* happening. The practice of observation in science and social inquiry is necessarily tied to and shaped by the experiences, culture, expectations, and training of the researcher (Chalmers, 2013). Thus, what researchers notice while engaged in unmotivated looking will vary. To support noticing in an unmotivated examination, Potter (2004) offered three questions that focus on identifying social actions and how they are constructed:

1. What is the language-use doing?
2. How is the language-use constructed to make this happen?
3. What resources are available to perform this activity?

As I engaged in unmotivated looking, the gisted meeting transcripts were revised to include more details pertaining to social actions and categorization practice. I noted various social actions, such as advice-giving, complaints, blame, questioning, and disagreeing, for example. With regard to the categorial organization, I took note of specific categories that participants used (e.g., gender, student, science). These social actions, categories, and other noticings then were added to the gisted meeting transcripts. In Figure 2, for instance, I noted in the Blocks column that a segment of the talk was a ‘critical point’. This was a moment when I noticed a disruption in the flow of conversation. I then used Potter’s (2004) questions to further examine what was happening at the critical points and noted the categories that were used during those moments.

Those notes informed my analytical decision to focus on how language was used to construct disagreements and the resources (e.g., questions, hedges, humor, pauses) for doing so.

### *Coding*

Coding is a general research practice that is carried out across research perspectives. In qualitative research more broadly, coding is a process whereby researchers use abstract words or phrases to describe and construct themes across stretches of talk (Saldaña, 2015). The coding procedures in EMCA are distinct from those carried out in other forms of qualitative inquiry (Stivers, 2015). Whereas qualitative researchers use either *a priori* or emergent coding practices to generate themes across data (Saldaña, 2015), EMCA researchers often code instances of a phenomenon as a means to generate patterns across social actions.  After unmotivated looking, analysts conduct inductive searches of social actions or considered candidate phenomena (Seedhouse, 2004). A candidate phenomenon is a specific social action (e.g., invitations, greetings) that is observed in the data. Once candidate phenomena are selected, these actions may be coded by the names of the specific social actions (e.g., invitation, complaint, etc.) and saved for detailed analysis once general patterns are noticeable.

The candidate phenomenon chosen for this study was disagreement. This choice was aligned with the methodological approach of this study and substantive interest in STEM graduate student teaching development as a reform strategy. The decision to study disagreement specifically is appropriate for at least two reasons. First, the goal of institutional applied CA is to describe how social actors use language to carry out their institutional business (Antaki, 2011). The primary institutional business of STEM graduate student teaching development is convincing the next generation of faculty to adopt new cultures and practices for teaching and learning (Brownell & Tanner, 2012; Connolly et al., 2016). By analyzing disagreements, it is possible to make visible the moments when, perhaps, the next generation of STEM faculty have not yet been convinced to change their practices. Disagreements, then, represent possible instances when the institutional business of STEM graduate student teaching development is impeded and, thus, warrants study. A second reason to focus on disagreements has to do with the continuity of meetings. While engaged in unmotivated looking, I found that participants treated disagreements as unexpected and disruptive events. Since the time allotted for meetings is often limited (e.g., 60-90 minutes), extended disagreements could significantly hinder participants' efforts to promote instructional change. Thus, a close study of disagreements could also provide insights into how facilitators effectively (or not) manage disruptions and reorient group members to the institutional goals. These things considered, a focus on disagreement was deemed relevant and important for this study.

Disagreements were coded using both the audio files and gisted meeting transcription Additional coding was done to situate the disagreement within its sequential environment. Specifically, I coded the activities preceding disagreement (e.g., discussion of evidence-based teaching), specific actions used in courses of disagreements (e.g., questions, complaints), the role of the speaker who initiated the disagreement sequence (e.g., student), the role of the speaker who the disagreement was with (e.g., peer, faculty), and the speaker who ended or transitioned from the disagreement (see Figure 3).

Figure 3

*Example Coding Sheet for Uncontested Disagreements*

| Dis.Category | 2nd Category | Preceding Activity | WHO | WITH | TRANSITIONER |
|---|---|---|---|---|---|
| GENERAL | COMPLAINT | DISAGREEMENT | STUDENT | FACILITATOR | PEER |
| GENERAL | QUESTIONING | EVIDENCE-BASED TEACHING | STUDENT | FACILITATOR | FACILITATOR |
| GENERAL | N/A | EVIDENCE-BASED TEACHING | STUDENT | PRACTICE | FACILITATOR |
| GENERAL | N/A | EVIDENCE-BASED TEACHING | STUDENT | PRACTICE | FACILITATOR |
| GENERAL | FEASIBILITY | EVIDENCE-BASED TEACHING | STUDENT | FACILITATOR | FACILITATOR |
| GENERAL | FEASIBILITY | EVIDENCE-BASED TEACHING | STUDENT | FACILITATOR | FACILITATOR |
| **GENERAL** | **NEGOTIATED** | EVIDENCE-BASED TEACHING | **STUDENT** | **FACILITATOR** | **FACILITATOR** |
| GENERAL | COMPLAINT | EVIDENCE-BASED TEACHING | STUDENT | FACILITATOR | CONTINUES |
| GENERAL | N/A | EVIDENCE-BASED TEACHING | STUDENT | PRACTICE | FACILITATOR |
| **GENERAL** | | **LARGE GROUP SHARE OUT** | **STUDENT** | **PRACTICE** | **FACILITATOR** |
| GENERAL | QUESTIONING | LARGE GROUP SHARE OUT | STUDENT | FACILITATOR | FACILITATOR |
| GENERAL | FEASIBILITY | LARGE GROUP SHARE OUT | STUDENT | FACILITATOR | FACILITATOR |
| GENERAL | COMPLAINT | PEER AGREEMENT | STUDENT | FACILITATOR | FACILITATOR |
| GENERAL | N/A | QUESTION/IDK | PEER | PEER | FACILITATOR |
| GENERAL | CRITIQUE | SHARING EXAMPLE | STUDENT | FACILITATOR | FACILITATOR |

This coding prepared the data for further analysis and building collections of disagreements.

***Building Collections of Disagreements and Preliminary Analysis***

Building collections of language-use and social interactions is a common practice in EMCA research (Seedhouse, 2004). This is linked to efforts to identify the normative practices within social interaction (Stivers & Sidnell, 2013). Demonstrating normative orientation does not require large sample sizes or instances. CA sometimes relies on large collections of talk-in-interaction to demonstrate patterned regularities in the talk, but a small number of cases that do not fit with the pattern (i.e., deviant cases) can also be used in support of an observed norm. For example, a researcher may collect 1,000 instances of greeting exchanges (call-response) that are mostly uniform. One instance could be used to demonstrate the (normative) preference for greeting exchanges by how the interaction unfolds if participants begin to account for why they did not return the greeting (call-no response). Stokoe (2012a) recommended that researchers interested in attending to both sequential and categorial aspects of language-use and social interaction should generate topic-focused collections from different settings to demonstrate how social realities are variably produced.

For this study, I used purposive sampling to build a collection of disagreements. Specifically, I used maximum variation and deviant case sampling strategies (Etikan, Musa, &

Alkassim, 2016) to identify both variation in the practices for producing disagreements, as well as specific cases that were observably outside of the normative practice. The final collection included 127 disagreements. For the preliminary analysis, I transcribed three distinct types of disagreements using Jeffersonian conventions. The transcriptions and recordings for these disagreements were then shared at a data session in December 2019. A data session is a meeting research meeting held with EMCA and other discourse analysts, to validate or challenge interpretations of the data, refine or redirect the analytical focus of a study, and strengthen transcription skills (Stevanovic & Weiste, 2017). The data session was recorded and reviewed to inform the next steps of the analysis.

***Generating Findings and Representative Extracts***

To generate findings, I began by reviewing sequential and categorial patterns within the gisted meeting transcripts, codes, feedback from the data session, and noting similarities and differences across disagreements. Based on these analytical materials, I was able to group the disagreements into three general types. I then searched the EMCA empirical literature base to review prior taxonomies and characterizations of disagreements sequences. The forms of disagreement in this study did not align neatly with previous taxonomies, thus a new one was developed for this study and described in Chapter 6. Following this, I transcribed 11 representative disagreements using Jeffersonian conventions to analyze the general patterns, variability, and deviant forms of disagreement. For this round of transcription, I specifically attended to delays, rising intonation, and other conversational features that have associated with disagreement in the EMCA literature base (e.g., Goodwin, 1983; Rees-Miller, 2000; Sacks, 1987). Additionally, I created categorial organization tables to examine shifts in category-bound activities, predicates, and other categorial aspects across sequences of disagreement (Table 9).

Table 9

*Example of a Categorial Organization Table to Analyze Category-Use in Disagreements*

| Speaker A 'Motivating Teacher' MCD | Speaker B 'Motivating Teacher' MCD |
|---|---|
| Category-bound activities | Category-bound activities |
| • Smiles | • *Does not always smile* |
| Standardized relational pairs | Standardized relational pairs |
| • Student-Teacher | • Student-Teacher |

As demonstrated in Table 9, using the MCA sensitizing concepts made visible the specific aspects of the categorizations were transformed through disagreements. In this example, only the category-bound activities shifted in the disagreement between Speakers A and B. These analytical practices helped to strengthen the connections between categorial and sequential analyses.

After this more detailed transcription and analysis, I searched the data for instances that deviated from the general patterns (Lester & O'Reilly, 2019). Deviant cases are key analytical resources for making visible how social actors respond to deviations from normative practices in social interaction (Maynard & Clayman, 2003). The detailed analysis of the sequential and categorial organizations of 11 representative excerpts, including deviant cases, was used to generate accounts of disagreements in STEM graduate student development meetings.

***Warranting Claims and Research Quality***

The concept of research 'validity' is widely debated across qualitative research paradigms, thus it is important to discuss the approach taken for this dissertation. The term validity generally relates to questions about whether research claims can be trusted, representative, or useful (the list goes on) (Dennis, 2013). I will not explore the extensive negotiation and debate of validity here, but it is worth noting that what validity or research quality (Tracy, 2010) is or what it should be is not agreed on. In keeping with my commitment to pluralism (Moss et al., 2009), I subscribe to an approach to validity that honors both the unique practices of ethnomethodologically-aligned research and attempts to relate these practices to those commonly used in qualitative research more broadly  (Lester & O’Reilly, 2015; Peräkylä, 2011; Seedhouse, 2004).

Writing and warranting claims are important parts in analysis and closely tied to research quality in EMCA. Since EMCA researchers claim that social actions and understandings of the social world are on display in/for interaction, part of writing up the description of this requires making visible both the social actions and understandings (i.e., what is built up) and the analysis (i.e., show how it is built up) (Antaki et al., 2003; Potter, 2012). The procedures for warranting claims in this study will involve distinctive practices related to ethnomethodological commitments. In Garfinkel’s (1967) terms, analysts strive to makes claims intelligible and analyzable for those who read the work. These practices include grounding claims in participant orientations through next turn validation, demonstrations of analytical claims, deviant case analysis, attending data sessions, and relating findings to past literature. I begin with the framing of this discussion in terms of research ‘validity’.

Warranting is a validity-adjacent process used in EMCA research whereby analysts ground knowledge claims through demonstration (Peräkylä, 2011). Warranting can be conceived of as a process by which researchers make their knowledge claims intelligible and accountable. Using detailed transcriptions of excerpts and references to the specific stretches of language-use and social action are central to the practice of warranting claims in ethnomethodological research. This allows readers opportunities to evaluate claims themselves based on chosen excerpts and potentially offer alternative interpretations (Sacks, 1984). The practice of writing up warranting procedures is necessarily normative and important but does not guarantee 'truth' or 'usefulness' of claims. Rather, as with any form of knowledge production, clarifying grounds for claims allows participants in research communities to assess claims and make progress in their intellectual pursuits (Kuhn, 2012).

Schegloff (1997) suggested that the appropriate grounds for warranting knowledge claims, along with the relevance of particular contexts and identities, should be grounded in participant orientations rather than the analysts' orientations. In EMCA studies, the notion of 'context' is conceived of as participants' phenomena rather than *a priori* input from the analyst. Sacks, Schegloff, and Jefferson (1974) described theorized that conversations were "context-free" and "context-sensitive" (p. 700). They argued that conversation has the potential to be general and specific (i.e., context-free) and for that reason, it is also "context-sensitive" because speakers orient to the relevance of social knowledge and settings within the interaction itself (p. 700). As such, it is not necessary (nor encouraged) to assume in advance the relevance of particular categories, settings, or characteristics of participants in the analysis or write up (Sacks, Schegloff, & Jefferson, 1974). Schegloff (1997) further argued that participants' orientations produce a "prima facie validity" that is constitutive of interactional realities (p. 171).

Sacks (1992) argued that because conversation is sequentially organized, social actors' understandings of the actions they co-produced should be evident from one turn to the next. The primary practice for demonstrating participant orientations is called next turn validation (Peräkylä, 2011; Schegloff, 2007a). The concept refers to the way that participants demonstrate or validate the meanings of the prior talk by displaying their understanding of previous utterances in the next turn. When a speaker constructs an utterance to ask a question, for instance, a second speaker may orient to this talk as a question by providing an answer. The second speakers' treatment of the first utterance, then, validates that the talk performed a question. However, some researchers have drawn attention to the difficulty with using next turn validation for social actions that are designed as ambiguous, including categorization and culture (Speer, 2017; Stokoe, 2012a). This is especially the case for those researchers who conduct research related to specific topics, categories, or identities. Given that this dissertation is partly focused on constructions of culture and categorizations that may be ambiguous in design, I grounded claims with both participants' orientations using next turn validation and offered my interpretation alongside demonstrations from data.

Demonstrations of analytical claims is a second key warranting practice in CA and MCA research. Researchers include transcribed excerpts of data and demonstrate the analysis by referring to specific turns of talk so that readers can trace the claims being made (Antaki et al., 2003). Peräkylä (2011) described the demonstration or transparency of analytic claims as a form of apparent validity: "once you have read [the claims], you are convinced that they are transparently true" (p. 36). To test early claims, discourse analysts typically attend data sessions with colleagues to gain feedback on analysis. Additionally, analysts may draw upon the findings from past EMCA and related literature as resources to support analytic claims and characterize social actions. Showing analysis, attending data sessions, and referencing previous studies are key processes for checking and validating research claims. These processes also can generate new insights and interpretations that a researcher on their own would not have considered. For this study, I attended one data session to receive feedback about a preliminary analysis of disagreements. I also drew upon the empirical literature based to inform the analysis of the sequential and categorial organizations of disagreement.

### *Ethical Considerations*

The ethical considerations of this study were shaped by the conventional code of ethics in social science research (Christians, 2011), IRB requirements, and my commitments. The procedures required by IRB at participating institutions were adhered to as a minimal safeguard to participants. However, as Christians (2011) argued, "IRBs in reality protect their own institutions rather than subject populations in society at large" (p. 67). While as a researcher I could not guarantee full protection of participants, I sought and ongoing, collaborative consideration of the potential risks throughout the research process. Ethical considerations include reflexive engagement with research with participants, transparency about the purpose of the study, and the engagement with the data.

Christians (2011) argued that at a minimum, social science researchers conventionally adopt four ethical guidelines to protect research participants: (1) informed consent, (2) avoidance of deception, (3) assurance of privacy and confidentiality, and (4) accuracy. For this study, I pursued both informal (i.e., non-required) and formal consent at multiple levels of stakeholders involved with each research site. Stakeholders included national network leaders, institutions, practitioner colleagues, facilitators, and individual group members. As discussed earlier in the chapter, I met with stakeholders on multiple occasions, shared a research synopsis for the study, and collaboratively considered the potential benefits risks to multiple stakeholders. Importantly, engagement with multiple stakeholders provided opportunities for transparency about the goals and possible benefits of the study.

First, it is important to address the reason I decided to exclude the WoC group from this study during the early stages of data analysis. As a facilitator of this group, I led teaching and professional development content that prioritized the holistic well-being of the graduate WoC participants. As a result of the emphasis on well-being in this group, we would often spend a significant portion of each meeting sharing vulnerabilities and negative experiences with marginalization, isolation, and significant challenges the participants were facing within their STEM departments. Following the participants' lead, I opted to place less emphasis on teaching development content in these meetings than was originally planned and instead held space for extended well-being check-ins and group processing for solidarity and support. This necessary shift in the focus of the meetings generated conversations that were not as closely tied to teaching and learning. Thus, I decided to exclude the WoC group because of the shift in the meeting focus and because the dataset generated from these meetings did not lend itself well to the analytic focus of the current study.

The second set of ethical considerations were step taken for the protection of the identities and representations of participants throughout data collection and analysis processes. Pseudonyms were assigned to all identifiable information for participants, institutions, and locations for publically disseminated materials (e.g., publication). For video and audio data files that would be publically available, the pitch of voices was modified and videos were cartoonized using Shotcut video editing software. These precautions were taken to reduce the possibility that participants would be recognizable to insiders of the broader NextSTEM network. As I wrote up the analysis, I considered how participants and their actions might be perceived in my narration of the findings. I attempted to write the findings from a generous interpretative position while characterizing the actions of participants. Finally, Pollner (1991) importantly argued that the act of writing up research to produces the knowledge about participants and their actions *as* concrete and stable, where they ought to be treated as tentative, contingent, and situated practice. To resist the concretizing that inevitably occurs in knowledge production, I wrote the findings using discursive markers for hedging (e.g., perhaps) to emphasize that the knowledge produced in this study is a constructed, unfinished account that could be interpreted differently by readers.

**Chapter Summary**

In this chapter, I discussed the research questions, methodological approach, research procedures, and analytical practices used for the study of STEM graduate student teaching development. These practices were linked to the theoretical orientation and commitments described in Chapter 3. In the next three chapters, I present the findings of the analysis of the institutionality of interaction for each research site (Chapter 5), the sequential and categorial analysis of disagreements (Chapter 6), and an analysis of deviant cases (Chapter 7).

# CHAPTER 5

# THE INSTITUTIONALITY AND INTERACTIONAL ENVIRONMENTS FOR DOING DISAGREEMENT IN STEM GRADUATE STUDENT TEACHING DEVELOPMENT MEETINGS

As discussed in earlier chapters, the extant literature about STEM graduate student teaching development has provided minimal insights into what participants *do* in teaching development meetings to support instructional change. The research on these practices has primarily been evaluation studies or relied upon self-report data (e.g., interviews), with few examinations of discourse or social interaction in these meetings. Furthermore, the practice of doing teaching development in STEM disciplines within higher education is underdeveloped and understudied (Austin, 2010; Connolly, Lee, & Savoy, 2018; DeChenne, Koziol, Needham, & Enochs, 2015). As noted in Chapter 2, the vast majority of the literature on STEM graduate student teaching development is based on studies of single programs and provides few insights into differences between the various approaches to teaching development. Thus, this study addresses both methodological and practical knowledge gaps (Miles, 2017). On the one hand, using applied conversation analysis (CA) and membership categorization analysis (MCA) generates knowledge about language-use and social interactions within these groups. On the other, this study is significant because it compared three different approaches to teaching development and generates knowledge about the actual practices of promoting instructional change in STEM higher education settings.

As discussed in Chapter 4, disagreement emerged as a prevalent social action across the three groups in this study. I use the term disagreement to refer to instances when one speaker expresses a view that is different or counters that of another speaker (Sacks, 1987; Sifianou, 2012). The findings of this study are separated into three chapters. This chapter includes the analysis of the interactional contexts for disagreement. Chapter 6 presents the sequential and categorial analysis of the forms of disagreement identified in each group. An analysis of deviant cases is presented in Chapter 7. The dissertation research question addressed in this chapter is:

- *What are the characteristics of the interactional contexts that participants co-constructed and oriented in meetings for multidisciplinary STEM, discipline-specific, and identity-based approaches to teaching development for graduate students and future faculty?*

For this chapter, I drew from the ethnomethodology and conversation analysis (EMCA) literature bases to analyze and describe the institutionally and interactional environments that shaped disagreement for each group in this study. Through this study of disagreement, I provide a discursive approach to the study potential barriers to and practices for promoting instructional change in STEM higher education contexts. This chapter situates the findings presented in Chapter 6 and 7 within the institutional contexts co-constructed in participants within each group. These contexts significantly shaped how interactions and disagreement unfolded within each group.

It is important to remind readers about how the notion of context is conceptualized in EMCA traditions. Schegloff (1997) argued that the appropriate grounds for warranting knowledge claims, along with the relevance of particular contexts and identities, should be grounded in participant orientations rather than solely by the analyst’s interpretation. Thus, in EMCA traditions, the notion of context is conceived of as participants’ phenomena rather than *a priori* input from the analyst. Sacks, Schegloff, and Jefferson (1974) described conversation as “context-free” and “context-sensitive” (p. 700). They explained that conversation has the potential to be general and specific (i.e., context-free) and for that reason, it is also "context-sensitive" because speakers demonstrate or orient to the relevance of particular identities and settings within interaction (p. 700). As such, they argued that it is not necessary to assume in advance the relevance of particular categories, settings, or characteristics of participants in the analysis or write-ups of findings. Schegloff (1997) also argued that participant orientation in social interactions is a type of “prima facie validity” that is constitutive of interactional realities (p. 171). Thus, interactional contexts in this study were conceived as phenomena produced by participants, turn-by-turn, and required analysis for the purpose of description.

**Chapter Overview**

This chapter comprises four sections. In Section I, the overall structural organization of meetings for each group is described. Section II presents the rates of disagreement to compare the frequencies of each group. In Section III, the activities preceding disagreements are described. Section IV presents the analysis of participants’ orientations to their institutional setting and roles. These features shaped the production and forms of disagreements for each group. Notably, three forms of disagreement were observed across the dataset: *uncontested*, *contested*, and *affiliative disagreement*. *Uncontested disagreements* are instances when a speaker introduces a disagreement that ends with either concession or is absent of disputes. *Contested disagreements* include back-and-forth disputes and, oftentimes, lack resolution (Kotthoff, 1993). *Affiliative disagreement* are a preferred form of disagreement in which one speaker offers a counter to negative self-assessments or self-deprecation (Pomerantz, 1984). These definitions are provided to support the reading of this chapter and will be discussed in detail in Chapter 6.

**Findings and Analytical Discussion**

The analysis below compares three types of graduate student teaching development: a multidisciplinary STEM learning community, a discipline-specific seminar, and an identity-based co-curricular learning community. Though the details of these groups are discussed in Chapter 4, I provide a brief description of each group to support the reading of the analysis in this chapter. The multidisciplinary STEM learning community (STEMU) was a 10-week course offered for graduate students and postdoctoral scholars. This group was part of a national initiative to support the next generation of STEM faculty to become effective educators and mentors. The discipline-specific group was a biomedical education journal club seminar (BME) that held synchronous videoconference meetings between group members at two institutions. The identity-based group was an affinity group for graduate-level women in STEM (WOM). This group was co-curricular teaching and professional development with a curriculum that focused on teaching, mentoring, STEM communication, and outreach.

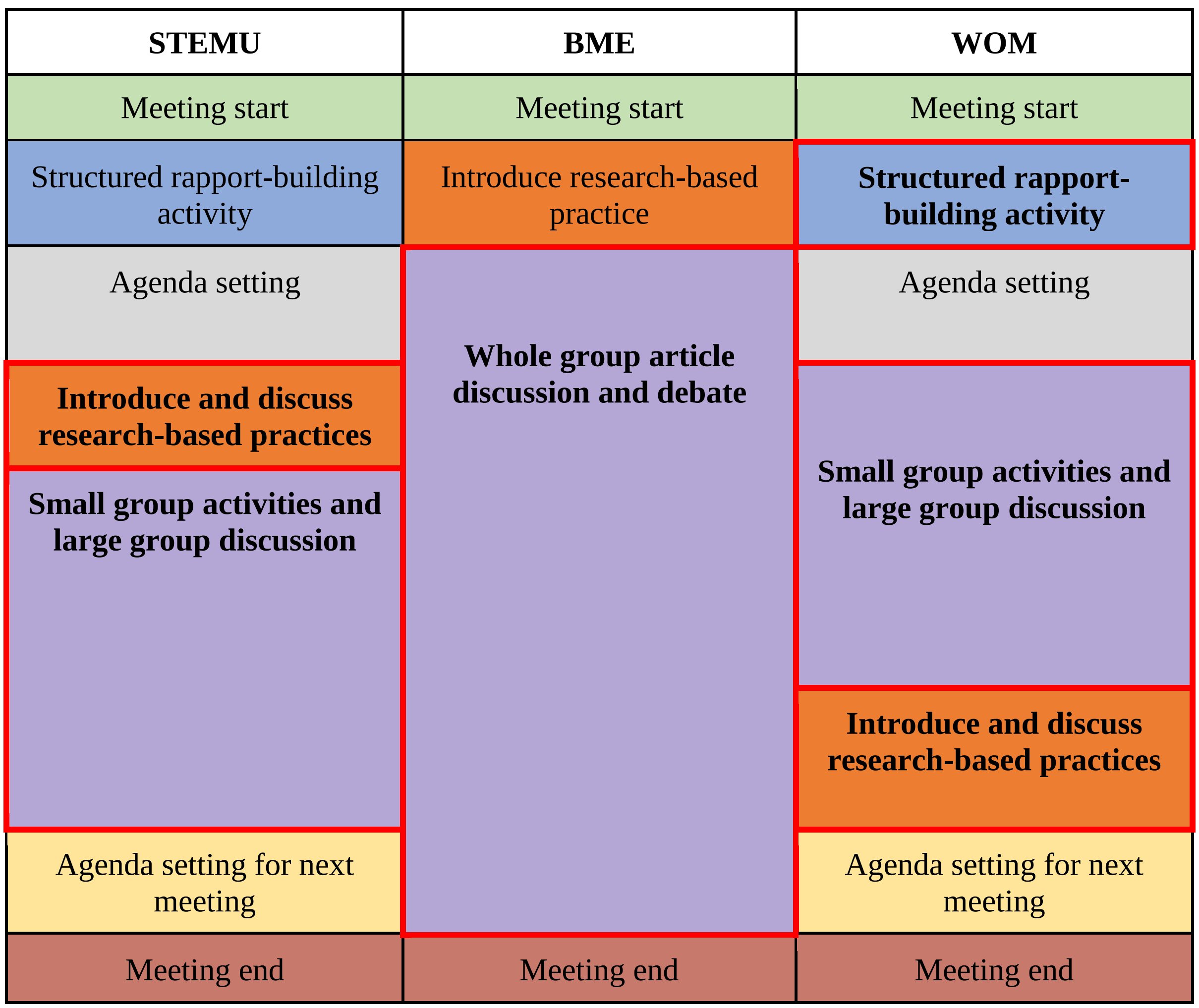
Four features were compared across groups for the analysis in this chapter: (1) overall structural organization of meetings, (2) rates of disagreement, (3) participants' orientations to the institutionality of interaction, and (4) activities preceding disagreements. These features were based on frequencies and turn-by-turn analyses of interaction using CA. While frequencies alone do not justify patterns in conversation analytical work or tell the complete story of discursive practice, they offer useful comparisons for characterizing patterns in social actions and the interactional contexts participants co-produced (Stivers, 2015). Overall, this section describes the landscape and interactional environments of disagreements within the three approaches to STEM graduate student teaching development. Throughout, I include an analytical discussion and reference relevant literature in keeping with the conventions for warranting claims in discursive and conversation analytic traditions.

***Section I: Comparison of Overall Structural Organization***

Robinson (2013) argued that the broader or supra-sequential context shapes both how actions are produced and which actions are allowable. The sequence of the meeting activities, such as introductions, agenda-setting, and other practices for organizing meetings, provide the interactional context for the kinds of social actions that are possible. This context is constructed, moment-by-moment, by participants in interaction and can be constrained by institutional roles and responsibilities (Garfinkel, 1967; Robinson, 2013).

Figure 4

*Meeting Structure by Group*



Each group included in the study had a distinct meeting structure and, for the most part, disagreements were located within similar activity blocks (Figure 4). For instance, all three groups included activities for introducing and discussing research-based practices for teaching and learning. Various forms of disagreement occurred within these activity blocks for all three groups. Disagreements did not occur during the beginnings or endings of meetings. This provides evidence that disagreements were not treated as allowable or relevant social actions within these activities.

The STEMU and WOM groups included structured rapport-building activities after the official start of the meeting. For example, one of the STEMU facilitators would often pose a question to students about their interests. During these activities, participants also celebrated important events (e.g., dissertation defense), shared personal insights, and encouraged each other. Disagreements did not occur during this rapport-building activity for the STEMU group. By contrast, affiliative forms of disagreements often occurred during a regular whole-group reflection activity done in the WOM group.  For this activity, a facilitator led a guided group reflection activity wherein participants shared high points and low points from prior weeks. Throughout the activity, group members offered support and affiliative disagreements in response to self-deprecating comments, for example. Unlike the STEMU and WOM groups, the BME group's rapport-building activities were often unstructured and occurred before, during, and after the official start of the meeting. The affiliative disagreement was the only form treated as allowable or relevant during structured rapport-building activities and only occurred with one group. Whereas disagreements of any kind were not treated as relevant or allowable during this activity block.

The broader sequential context, thus, was linked to both the location and type of disagreement that occurred within STEM graduate student teaching development meetings. Despite each group taking a different form, disagreements were treated as allowable and relevant during activity blocks wherein participants introduced and discussed research-based practice. Disagreements were also treated as allowable during structured rapport-building activities, but only for the WOM group. The disagreements that occurred were almost exclusively affiliative, which may be linked to other social practices treated as appropriate during rapport-building activities (e.g., self-deprecation). Overall, disagreements were expectable during the introduction and discussion of research-based practices for teaching and learning.

### *Section II. Rates of Disagreement*

The rate of disagreement varied by group and meeting. The rate of disagreement was calculated by dividing the number of disagreeing points by the meeting length in minutes (e.g., 27 disagreements/55 minutes). A disagreeing point is an instance when one speaker states a different view or point counter that of another speaker. A disagreement sequence, by contrast, includes disagreeing points and responses to them, which may be concessions, resolution or markers of resolutions, or more disagreements (Kotthoff, 1993; Sacks, 1987). Given the complexity and multiple components involved in disagreement sequences, this subsection focuses solely on individual disagreeing points to compare group the differences in the frequency that participants treated the practice of sharing disagreeing points as allowable or relevant. These rates also provided evidence for claims about each group's orientation to disagreement. The patterns across disagreement sequences will be addressed in Chapter 6.

Table 10

*Number of Disagreeing Points per Recorded Meeting*

| | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| STEM | 3 | 5 | 3 | 6 | 8 | 14 | 39 |
| BME | 27 | 8 | 19 | 5 | 8 | | 67 |
| WOM | 11 | 2 | 3 | 5 | | | 21 |
| | | | | | | Total | 127 |

Note: The cells of the table are conditionally formatted to highlight the differences between lower and higher numbers of disagreeing points in each recorded meeting. Lower and higher numbers of disagreeing are represented with lighter and darker colors, respectively. The meetings are numbered to represent the sequence that they occurred for during the data collection period.

Table 11

*Rates of Disagreement per Recorded Meeting*

| | 1 | 2 | 3 | 4 | 5 | 6 | Avg. |
|---|---|---|---|---|---|---|---|
| STEM | 0.04 | 0.06 | 0.04 | 0.06 | 0.09 | 0.15 | 0.07 |
| BME | 0.52 | 0.37 | 0.16 | 0.08 | 0.16 | | 0.26 |
| WOM | 0.17 | 0.03 | 0.04 | 0.09 | | | 0.08 |

Note: The cells of the table are conditionally formatted to highlight the differences between lower and higher rates of disagreement for each recorded meeting. Lower and higher rates of disagreement are represented with lighter and darker colors, respectively. The meetings are numbered to represent the sequence that they occurred for during the data collection period.

On average, the BME group had the highest rate of disagreeing points introduced during meetings (Tables 10 and 11). This group was characterized by disagreement and included extended back-and-forth exchanges or debates over the course meetings. The BME group also had a higher proportion of contested disagreements than the other two groups. By contrast, disagreeing points were less frequent in the STEMU and WOM groups. In the STEMU group, disagreements often occurred in clusters with one person offering a disagreement followed by one or two other speakers introducing related or unrelated disagreeing points. Similarly, disagreeing points in the WOM group were infrequent, with a third of the disagreements being the affiliative form. The BME group demonstrated a stronger orientation to disagreement in terms of frequency and form compared to the other two groups. Disagreements in the BME group were often direct and strong, whereas presenting alternative views were performed and treated more delicately in the other two groups.

Heritage (1984) argued that a bias for social solidarity is among interactants, positioning some actions, such as disagreement, as going against the grain of the norms in social interaction. Others have demonstrated that disagreement, particularly the strength and weakness of it, may also be indicative of the level intimacy, friendship, or strength of the relationship (Romera, 2018; Schiffrin, 1984). Romera (2018), for example, argued that strong disagreement is allowable in strong relationships because it presents a low risk of negatively impacting the relationship, whereas weak disagreements are more likely to occur in weaker relationships. Thus, the rate of disagreeing is only part of the story. How disagreements unfold – sequentially and categorically – can provide more insights into the creative practices social actors use to navigate disagreement in variable relational contexts.

***Section III: Activities Preceding Disagreements***

Sack (1987) argued that it is difficult to predict what speakers will take exception to or disagree with. Sifianou (2012) also claimed that disagreements are a unique type of social action. Compared to other types of actions (e.g., requests, compliments), disagreements are responses to prior actions. Given that disagreements can be somewhat unpredictable and are often reactions to other social actions, I coded the data by the types of activities and actions that preceded each disagreement to assess for similarities and differences across the groups.

Table 12

*Types of Activities Preceding Disagreements*

| Activity | n | % |
|---|---|---|
| Discussion of evidence-based practice | 39 | 30.7 |
| Share ideas or suggestion for practice | 27 | 21.3 |
| Disagreements | 17 | 13.4 |
| Assessments | 12 | 9.5 |
| Sharing opinions | 10 | 7.8 |
| Other: complaints, stories, excuses | 8 | 6.3 |
| Critique | 7 | 5.5 |
| Skeptical comments | 4 | 3.1 |
| Large group discussion | 3 | 2.4 |
| Total | 127 | 100 |

Table 13

*Activities and Actions Preceding Disagreement by Group*

| BME | | STEMU | | WOM | |
|---|---|---|---|---|---|
| Activity | n | Activity | n | Activity | n |

| | | | | | |
|---|---|---|---|---|---|
| Discuss evidence | 27 | Disagreement | 10 | Ideas/suggestions | 5 |
| Ideas/suggestion | 13 | Discuss evidence | 8 | Assessments | 5 |
| Critiques | 7 | Ideas/suggestions | 9 | Discuss evidence | 4 |
| Disagreements | 7 | Opinions | 4 | Opinions | 3 |
| Assessments | 4 | Assessments | 3 | Self-deprecation | 3 |
| Skepticism | 4 | Large group discussion | 3 | Stories | 1 |
| Opinions | 3 | Other | 2 | | |
| Other | 2 | | | | |

I identified 16 different types of activities or actions (Table 12), the most frequent ones being discussions of evidence-based practice, sharing ideas or suggestions for practice, and prior disagreements. Each group varied in the types of activities or actions that proceeded disagreement (Table 13). In the BME group, the majority of disagreements occurred after comments or statements about evidence-based research. This group also had the most types of activities that preceded disagreement, which indicates that there were multiple points at which disagreements could be introduced. By contrast, disagreement in the STEMU group occurred most frequently after other disagreements. This finding can be linked to the discussion in Section IV that disagreements disrupted the progressivity of IRE sequential practice that typically occurred in that setting. These disruptions were often be followed by clusters of disagreements. This finding highlights that one participants' disagreement may have offered a strategy for others to introduce their disagreeing points in an interactional environment with limited opportunities to do so. Given the rarity of disagreements in the WOM group, there were few activities preceding disagreements. Activities that preceded affiliative actions, however, were most common.

Affiliative disagreements in this group were most often preceded by ideas, assessments, self-deprecation, and stories.

A detailed analysis of actions and activities preceding disagreements is beyond the scope of the current study. Given that over half of the disagreements were in response to discussions of evidence-based research and ideas or suggestions for practice, however, the findings of this study warrant future analyses of these practices.

### *Section IV: Participant Orientations to the Institutionality of Interaction*

In applied CA, special attention is given to how institutional norms, identities, and goals shape how interactants carry out their business (Antaki, 2011; Heritage & Clayman, 2001). The talk within institutional settings (e.g., classrooms, courtrooms) is different from everyday conversation in at least three ways: turn-taking, sequence organization, and repair (Gardner, 2013). In teacher-centered classrooms, for example, teachers have privileged rights for maintaining the floor, allocating turns, starting and ending sequences, and initiating repairs, compared to everyday interactions. Students typically must raise their hands to be selected and the teacher often decides who is allowed to take a turn. In this context, teachers have special rights to turns and, therefore, the sequences of action that are permitted. The participants – the teacher and students – orient to and work together to produce the institutional environment for interaction. The institutional character of interaction, however, cannot be assumed prior to analysis. Schegloff (2007a) argued that claims to participants' orientations to institutional rights, identities, and roles should be demonstrated through analysis.

Each group in this study demonstrated distinctive orientations to institutional roles, rights, and obligations. In this subsection, I discuss each group in terms of key differences in turn-taking and sequence organization. I excluded a comparison of practices for repair for two reasons. First, the form of repair that occurred in each group was almost exclusively the most preferred type: self-initiated self-repair (Schegloff, Jefferson, & Sacks 1977). Given similarity across groups, a comparison of repair practices was not meaningful. Additionally, the focus of this study is on disagreement sequence organization. Previous EMCA studies have shown that repair can overlap with or be a feature of disagreement sequences (e.g., Goodwin, 1983; Hüttner, 2014). Therefore, the discussion of repair, where relevant, is reserved for Chapter 6 where I present the analysis of disagreement sequences.

***BME.*** Turn-taking and sequence organization in this group were distinct from interactions in typical classroom settings. While the group pre-selected one student as the discussion leader for each meeting, participants freely self-selected turns and initiated sequences of their choosing. In the opening of a meeting, one of the group advisors reminded others that a research recording was in progress. Before this, participants were discussing dry needling and pie that they were eating during the meeting. The following excerpt illustrative of how participants marked their institutional identities and roles during openings of meetings. The advisor and student roles are bolded and noted in the excerpts below to highlight the analytical points of consideration.

*31:10:19: BME Meeting Opening*

GRP: ((informal conversation and discussing pie))

**MAL:** okay (.) just as a reminder um uh Francesca is
recording [now too] **((<-advisor))**

REN: [oh]

MAL: but we're talking dry needling and all kinds
of stuff too (.) in case you're wondering why we
have the black screen and we've got Zoom but
Donovan's here

STE: a:wkward don't tell him that

GRP: ((group laughter))

**REN:** alright (.) hello everybody **((<-discussion lead))**

STE: he has plenty of time to drive back to((home))
and then come back ya know

REN: very sorry you didn't get the articles until very
early yesterday **((continues with explanation for
why articles were selected))**

The institutional leaders (e.g., faculty, advisors) were somewhat undetectable other than instances when they shared announcements or news. In the excerpt above, the institutional leader (Mallory) reminded participants that official business (i.e., research) was underway. Mallory proceeded to justify why videoconferencing was still occurring because a group member who usually joined meetings by videoconference was present in-person (Lines 8-12). Following this, presumably informal topics (e.g., dry needling) were set as off-limits and Mallory's talk marked a possible transition to more formal topics of discussion. Steven, however, maintained aspects of informality by initiating a humor sequence (Line 13-20). The discussion leader formally began the meeting (Line 17-24), in which part of the humor sequence ending occurred (Lines 19-20). Sequentially, the speaker's self-selection and introduction of humor sequence were indicative of the flexibility of turn-taking and sequence organization that is similar to everyday conversation (Sacks, Schegloff, & Jefferson, 1974). Still, the discussion leaders oriented to their role by formally start the meeting with a greeting (Line 17), apology, and explanation for why the weekly reading was selected (Lines 23-24). The opening of each meeting was the main component that marked the institutionality of interaction for this group.

Throughout the remainder of the meeting, discussion leaders played an important role in guiding group conversations. The discussion leader often posed critical questions and linked group members' comments to the article being discussed. Compared to a teacher-centered classroom setting wherein the teacher introduces and transitions topics, all participants in this group posed questions, introduced topics, and managed transitions. This may be indicative of a somewhat nonhierarchical structure wherein the common advisor-student power difference is not as consequential in interaction as would be expected. An example from a disagreement involving two students and an advisor (Phoebe) illustrates inconsequentiality, at the moment, between a student discussion leader and advisor roles:

*31:10:19: BME Student-Advisor Interaction*

PHO: [I don’t think it’s (.) feasible]

REN: [then I don’t know that] in this particular sense
I don’t know that it’s useful (.)I don’t think
it’s moving toward where they were suggesting not
saying it has to be this way

**PHO:** it’s better than nothing= **((<-advisor))**

**REN:** =it’s better than nothing I’m just saying relating
to this specific to this article I don’t think
that takes them all the way to where they are **((<-
student and discussion leader)**

Before this interaction, Renee and Donovan were involved in a contested disagreement about whether pre-set feedback about multiple-choice questions was an effective practice to support learning. After several students offered support for each side of the disagreement, Phoebe responded by offering weak support (Line 32) for Donovan’s disagreement. Discourse studies in diverse contexts have demonstrated that power differential can significantly impact how disagreements take place and whether they can be maintained (Argaman, 2009; Lazzaro-Salazer, Marra, Holmes, Vine, 2015; Paramasivam, 2007). In their study of decision-making in meetings, for instance, Lazzaro-Salazer and colleagues (2015) found that even arbitrarily assigned hierarchies can alter courses of disagreement and reduce the likelihood that participants will explicitly express their objections. Given Phoebe’s institutional role, even weak support against

Renee's argument could have discouraged the maintenance of disagreement. However, Renee maintained and upgraded the disagreement by referencing the research article under discussion to further ground her claim (Lines 34-36). In this instance, Renee also oriented her role as a discussion leader by linking their discussion to the article of the week.

The turn-taking and sequence organization in the BME group made visible a mostly nonhierarchical and arguably student-centered interactional context. Even though this group was a credit-bearing course, the interactions and institutionality of the group were distinct from teacher-centered classrooms. Aside from the role of discussion leader, participants' oriented to interactional context as if the rights for taking turns, introducing and transitioning topics, and initiating and ending sequences were equal. Additionally, power differentials between group members were not as evident or consequential in social interaction compared to the STEMU group. It is important to note that this group had the highest rate of disagreement. It can be inferred that the participants' orientations to institutional roles and the mostly nonhierarchical structure they co-produced constructed an interactional environment that was conducive to doing disagreement.

***STEMU.*** The STEMU learning community was more akin to a traditional, teacher-centered classroom setting. Some of the features McHoul (1978) identified features of traditional classroom interaction that make it distinct from everyday conversation:

- Teachers allocate turns to students
- If the teacher does not select a student, the teacher must continue speaking
- Student speakers may only address the teacher
- Gaps and pauses are maximized
- Minimal overlap of talk occurs because students do not self-select turns

In a traditional classroom, then, a hierarchical structure is expected and conventional. The co-instructors in this group managed all turn-taking and speaker selection, had privileged rights for opening and closing sequences, and were primarily the persons to introduce and transition topics. Instructors also had three specialized practices that marked the institutionality of interaction and pointed to possible interactional constraints on doing disagreement in this group: a summons-acknowledgement practice, third-position evaluations, and invitations to speak. During the first meeting of the term, an instructor introduced a summons-acknowledgement practice to signal the end of small group discussion. For this practice, an instructor raised their hand (i.e., summons) and participants were to respond by raising their raise their hand to acknowledge the end of small group discussions. This practice was implemented in later weeks to signal the beginning of a meeting or end small group talk. It was also exclusively done by instructors, demonstrated that they had privileged rights to deciding when talk should begin and end.

The second practice that marked institutional identities and roles of speakers in this group was third-position evaluation. The third-position task was initially characterized by Sinclair and Coulthard (1975) as feedback practice as part of Initiation-Response-Feedback (IRF) sequences produced in classroom discourse. Later, Mehan (1979) characterized the Initiation-Response-Evaluation (IRE) sequence based on an ethnography of classroom interaction that included feedback or other evaluative tasks in the third position of the sequence. In the IRE sequence, a teacher poses a question, often with questions they already know the answer to (*Initiation*), students respond or are invited to respond (*Response*), and teachers follow up with an evaluation of the students' response (*Evaluation*). Empirical studies have demonstrated that the IRE sequence supports the progressivity of classroom interactions and is most common in settings where teachers manage turn-taking (Gardner, 2018; Lee, 2007; Macbeth, 2003; Nathan, Eilam, Kim, 2007; Zemel & Koschmann, 2011). The talk in the third position-evaluation of the IRE sequence serves many functions that contribute to the institutional goal of learning in classroom interactions. Example functions include making visible instructional goals, affirming student responses, initiating corrections of student responses, and making connections to learning goals (Gardner, 2013). Evaluations in teacher-centered classrooms are almost exclusively performed by teachers as they have privileged rights to evaluating student responses (Lee, 2007). The following excerpt illustrates an instructor (Carrie) performing a third-position evaluation of a student's (Tabitha) response. Prior to this, Carrie asked that class what instructors could do to motivate students to learn topics they may not be interested in (*Initiation*):

*16:10:19: STEMU Third-Position Evaluation*

TAB: =like and that was the most important thing that
was just so motivating to me that (.) there was
this (.) belief (.) from the teacher that I
could do it↓ (.) and sometimes even if something
sounds boring↓ (.) if the teacher's excited
about it or a teacher shows a belief in a
student↑ or the instructor then that in and of
itself can be motivating beyond something that
you think is gonna not (.) be interesting↓=

**CAR: =absolutely (.) absolutely I I think that's a**
**really good point uh I (.) looking back on that**
**I think I've experienced that quite a bit as**
**well (.) um but I think (.) I really hope that**
**we're gonna get to talk about this later and I'm**
**talking to Rema about it but that's kind of a**
**growth mindset idea that I'd like to talk to you**
**more about how to foster a growth mindset where**
**it's possible to achieve these things that we're**
**doing and so I'm glad that you brought that up**
(.) um Sachika ((selects next speaker))

In this excerpt, Tabitha offered possible solutions for motivating students (*Response*). Carrie's third-position evaluation of the response performed multiple functions, two of which are particularly relevant to this analysis. First, Carrie positively assessed Tabitha's comment (Lines

11-12) and validated them against her own experiences (Line 12-14). No additional explanations or justifications were requested, marking the comments as unproblematic. Next, Carrie tied the comments to a future curricular goal of discussing the growth mindset (Lines 16-20). This further legitimized Tabitha's suggestion and aligned it with the curricular goals of the group. As we will see in Chapter 6, another student eventually offered a disagreement with aspects of Tabitha's comments. Disagreements in this interactional context were complicated by both institutional identities and privileges. As was done in this case, disagreement with a peer also required the speaker to disagree with an instructor's third-position evaluation. This complexity was further evidenced in how delicately disagreeing points were introduced in this group.

The third specialized practice that marked the institutionality of this group was invitations to speak. Compared to the other two groups wherein speakers freely self-selected turns, students did not take turns unless they were invited to do so. These invitations occurred in three main places: 1) after instructors introduced evidence-based research with accompanying PowerPoint slides, 2) after Initiation practices (e.g., asking students questions, providing guiding prompts), and 3) after "think-pair-share" or small group discussion activities. Disagreements in this group were only offered when students were invited to speak. At the end of presentations about evidence-based teaching, for example, an instructor would say: "alright (.) let's pause here (.) any questions?". Students would respond by asking clarifying questions or use their turn to offer a disagreement. Similarly, when students were invited to share with the whole class what their group or pair discussed during "think-pair-share" activities, students either completed the requested task or offered disagreements. Thus, all invitations to speak provided opportunities for speakers to use their turns to initiate disagreement sequences. Because turn-taking was curated by instructors, participants' opportunities for introducing disagreements were constrained by whether they were selected and the number of opportunities students were invited to speak. Additionally, disagreements were exclusively closed by instructors with statements. Instructors would say “okay (.) let’s move on” to close the disagreement. I did not find any instances when student speakers initiated or modified closures of disagreement. Therefore, while students could use their turns to initiate disagreements, instructors had privileged rights for moving on from them.

The production of disagreements was significantly constrained by institutionality and the interactional context that the participants in the STEMU group co-produced. Instructors in this group demonstrated privileged rights to starting and ending talk, evaluating student responses, and deciding when students could speak. Disagreements typically occurred following third-position evaluations, occurred in clusters, and disrupted the flow of IRE sequences enacted in this environment. Following these disruptions, speakers worked to re-start IRE mode of interaction. Disagreements in the STEMU group unfolded in the following sequence:

1. *Pre-disagreement*: IRE sequences
2. *Disruption of IRE sequence*: student initiates of disagreement sequence
3. *Disagreement clustering*: initiation of additional disagreement sequences that are related or unrelated to initial disagreement (optional)
4. *Disagreement sequence closure*: instructor initiates close of disagreement sequence(s)
5. *Post-disagreement*: Instructor resumes IRE sequence

Thus, the participants’ orientation to the institutionality as well as the general sequential mode of the group significantly shaped how disagreement could be done in this group. All disagreements were directly or indirectly done with facilitators in complex sets of circumstances, primarily asymmetry of rights for and access to doing disagreement.

***WOM.*** Similar to the BME, participants in the WOM group had a produced a loosely structured hierarchy and oriented to leadership among group members. Peer facilitators rarely selected speakers, all participants initiated and ended sequences, peers orientation to their role as active in introducing evidence-based research practice in alignment with the institutional and curricular goals. The following excerpt illustrates how peer participants offered suggestions, without invitation, about how to implement evidence-based practice in large classrooms:

*17:10:17: WOM Peer Participation*

**MEL: but I think technology is making it a lot easier**
**((<- peer))**

JEN: yeah **((<-peer facilitator))**

MEL: to do whatever you want in the classroom

JEN: yeah

**KIM: I suggest that if you if you haven't heard of him**
**Eric Mazur (.) he's a physicist and at Harvard**
**he's at Harvard physicist slash professor at**
**Harvard and he is extremely dynamic at getting**
**students interactive in a physics classroom**
((followed by peers providing additional examples
that))**((<- peer))**

Just before this exchange, Melissa disagreed with the peer facilitator, Jenny, who characterized non-lecture activities as “hard” to implement in large classrooms. Melissa grounded her disagreement with an example of another instructor using technology in a large classroom. Kim, another peer provided support for the disagreement by suggesting additional resources and examples of instructors using non-lecture teaching practices large classrooms (Lines 10-14). Following this, several other peers added examples of evidence-based teaching. The pre-determined hierarchical structure did not appear to limit peer contributions, the introduction of topics, turn-taking for this group, or disagreements in this group.

However, disagreements were rare in the WOM group. When disagreements did occur, they were often affiliative disagreements. As a reminder, *affiliative disagreement* is a preferred form of disagreement in which one speaker offers a rebuttal to negative self-assessments or self-deprecation, for example (Pomerantz, 1984). This form of disagreement aligns with the presumed bias for social solidarity (Heritage, 1984), which is similar to how agreements are performed interaction (Pomerantz, 1984; Sacks, 1987), and is, therefore, a normative response to negative self-assessments and self-deprecation. Affiliative disagreements in this group would often occur when a WOM group member would share an idea and characterize it as "stupid" or express worry that they were failing their student. Group members would offer immediate and direct disagreements with these negative self-assessments. The majority of the disagreements that occurred in this group were of the affiliative type. This, along with the near absence of other forms disagreements, provides evidence for a strong affiliative orientation for this group. In can be inferred that this affiliative orientation was likely at odds with or minimized interpersonal conflict, and therefore was not conducive to non-affiliative forms of disagreement.

***Summary of Findings***

Now, I summarize the findings of the analysis above to address the research question.

**Research Question 1.** *What are the characteristics of the interactional contexts that participants co-constructed and oriented in meetings for STEM, discipline-specific, and identity-based approaches teaching development graduate students and future faculty?*

The analysis above compared multidisciplinary STEM, discipline-specific, and identity-based approaches to teaching development. The findings demonstrated that interactional environments significantly impacted how social actions, specifically disagreements, could be produced and managed. Two main aspects of interaction that participants co-produced and oriented to characterized each group in this study: *participants' rights* and *group orientation to disagreement.*

The BME and WOM groups were characterized by shared rights to turn-taking, initiating and ending sequences, and introductions to and transitions from topics of discussion. Participants in these two groups also oriented to group meetings as mostly non-hierarchical given that role asymmetries were not as evident, consequential, or constraining in interaction as would be expected. The STEM group, by contrast, was characterized by teachers' privileged rights to allocating turns, sequence organization (e.g., IRE sequence mode), and topic management. Though the STEMU group included elements of what is generally considered student-centered practice (e.g., "think-pair-share" activities), the interactions demonstrated asymmetry in rights between students and teachers and, therefore, constrained how social actions could be performed. Thus, each group was characterized by whether participants either maximized (i.e., shared rights) or minimized (i.e., privileged rights) field of possibility for doing disagreement.

The participants' orientation to disagreement also characterized each group. The BME group demonstrated a strong orientation to disagreement. This orientation was evidenced by the rate, forms, and strength of disagreement. The WOM group, by contrast, demonstrated a stronger tendency toward affiliative actions and a weaker orientation to disagreement.  This groups' institutional goal to provide a space for solidarity among women in STEM, in addition to discussing evidence-based practice, was seemingly at odds with social actions that would undermine group cohesion. The STEM group also showed a weaker orientation as evidenced by lower rates and delicate forms of disagreement. The groups' orientation disagreement was a key characteristic of the interactional context that could also be complicated institutional goals.

In summary, in environments with shared rights and where disagreement was not at odds with the institutional goal of the group, participants had many opportunities to do disagreement. These characteristics may also be markers of the strength of relationships, rapport, and collegiality among group members. The disagreements in this study were most often in response to the introduction of evidence-based research and suggestions for practice. This demonstrates that disagreement is a core activity in the STEM graduate student teaching development change strategy. As will be discussed in the final chapter of this dissertation, these findings have significant implications for research and practice.

**Chapter Summary**

In this chapter, I shared the findings of an analysis of the characteristics of three approaches to STEM graduate student teaching development. Specifically, frequencies for disagreement and turn-by-turn analyses were used to ground claims about how participants co-constructed and oriented to the institutionality and the interactional contexts they produced. These interactional contexts were then linked to the constraints and possibilities for doing disagreement in these meetings. I found that each groups' orientation to *participants' rights* and *disagreement* were two defining features that differentiated the interactional environments for doing disagreement. These findings contextualize the analysis of forms of disagreement presented in the next chapter. The next chapter presents the sequential and categorial analyses of disagreement sequences.

# CHAPTER 6

# AN ANALYSIS OF THE FORMS OF DISAGREEMENT IN STEM GRADUATE STUDENT TEACHING DEVELOPMENT MEETINGS

This chapter presents the findings from the analysis of the sequential and categorial organizations of disagreement sequences in STEM graduate student teaching development meetings. A disagreement sequence includes the initiation, responses to, and closures of disagreements between social actors (Kotthoff, 1993; Schegloff, 2007a). In this dissertation, the term disagreement refers to instances wherein one speaker expresses a view that is different from that of another speaker (Sacks, 1987; Sifianou, 2012). The second and third research questions of this dissertation that are addressed in this chapter are:

- *How are disagreement sequences produced and managed in teaching development meetings for STEM graduate students and future faculty?*
- *How are categories used in the production and management of disagreement sequences in these meetings?*

Through this study of disagreement, I provide a discursive approach to the study of a key instructional reform strategy in higher education: STEM graduate student and future faculty teaching development (Austin, 2010; Connolly et al, 2016). Methodologically, this dissertation combined applied conversation analysis (CA) and membership categorization analysis (MCA) to attend to sequential and categorical organizations in tandem to contribute to the analytical approach to studying disagreement, in this case, within STEM graduate student and future faculty teaching development meetings.

## Chapter Overview

This chapter comprises three sections. Each section presents the analysis of one of the three forms of disagreement identified in the dataset: *uncontested*, *contested*, and *affiliative*. An *uncontested disagreement* (Section I) is a sequence that introduces a disagreement that ends quickly with either concessions or acknowledgments, and is absent of disputes. *Contested disagreements* (Section II) are disagreements that lead to back-and-forth disputes and sometimes lack resolution (Kotthoff, 1993). *Affiliative disagreements* (Section III) are a preferred form of disagreement and are typically responses to negative self-assessments or self-deprecation (Pomerantz, 1984).

## Findings and Analytical Discussion

Below I present the findings and analytical discussion of disagreement sequences. In keeping with EMCA conventions, I reference relevant literature and past empirical studies to ground analytical claims. This section explores a modification of a fundamental question in ethnomethodological inquiry: "why that [disagreement], in that way, right now?" (Heritage, 1984, p. 151). A total of 127 disagreeing points were identified across the three groups included in this study. Of these, 81 were uncontested, 37 were contested, six were affiliative, and three were deviant cases. The analysis and discussion of the deviant cases are reserved for Chapter 7.

As discussed in Chapter 4, previous taxonomies of disagreements have been based on the strength and weakness of mitigation (Goodwin, 1983), grounded versus ungrounded forms (Blum-Kulka, Blondheim, & Hacohen, 2002), orientation to politeness (Rees-Miller, 2000), and functions of disagreement (Muntigl & Turnbull, 1998). Notably, the typology offered in this dissertation is distinct from previous ones as it is based on how quickly disagreements are ended and the practices social actors use to maintain disagreement at the expense of potentially increasing threats to face (Brown & Levinson, 1987; Goffman, 1967). Simply put, this study explains the differences between disagreements that end quickly and those that keep going. Given that EMCA scholars have claimed an underlying bias for solidarity (Heritage, 1984) and preference for agreement (Pomerantz, 1984; Sacks, 1987) in social interaction, a taxonomy based on whether disagreements are maintained can shed light upon the varied ways in which social actors flexibly negotiate solidarity and agreement under particular interactional circumstances. Additionally, this study adds to the literature by explaining some of the functions of preferred or affiliative forms of disagreements. For this analysis, I drew upon the empirical EMCA literature base, past disagreement taxonomies, and cross-cutting aspects of social interaction to analyze and describe the forms and functions of disagreements in STEM graduate student teaching development meetings.

To support the reading of the analysis, I first provide a brief discussion of preference organization (Pomerantz, 10984; Sacks, 1987), politeness (Brown & Levinson, 1987), and the importance of interactional contexts for disagreement. Table 14 provides a summary of some of the interactional features of agreements and disagreements characterized in the EMCA literature base (Goodwin, 1983; Pomerantz, 1984; Sacks, 1987).

Table 14

*A Comparison of the Interactional Features of Agreement and Disagreement*

| Features of Agreement | Features of Disagreement |
| --- | --- |
| • Preferred, except in response to negative self-assessments and self-deprecation | • Dispreferred, except in response to negative self-assessments and self-deprecation |

| | |
|---|---|
| • Agreements are often direct and immediate<br>• Often second-position agreements are upgraded (e.g., “they’re great” → “they’re amazing!”)<br>• Minimization of gaps | • Often prefaced with “well”, “uhs”, or repair initiators (e.g., “hm” or “what?”)<br>• Take many forms, including unstated and stated disagreements<br>• Include delays, gaps, and silence<br>• Often include overlaps<br>• Often include contrastive elements with agreement tokens and partial or qualified agreements (e.g., “that makes sense, but…”) |

Sacks (1987) argued that two preference organizations are evident in the production disagreements: *preference for contiguity* and *preference for agreement*. In general, talk is sequentially organized, with units of talk that occur one after the other and have organization between them (Sacks, 1992). Agreements are generally immediate, direct, and, therefore contiguous between adjacency pairs (first pair part or FPP and second pair part or SPP) (Pomerantz, 1984; Sacks, 1987). An example agreement that demonstrates contiguity is an invitation (FPP), “would you like to grab coffee?”, and the response, “yes, of course” (SPP). The acceptance of the invitation is at the beginning of the SPP and maintains contiguity of the invitation-acceptance adjacency pair.

Alternatively, an example rejection response to an invitation is “I appreciate the invitation, but I have to collect dissertation data all morning” (SPP). In this case, the answer to the invitation is prefaced with a politeness token (i.e., “I appreciate the invitation”) at the beginning of the turn and followed by a report of schedule conflict that ultimately performed the rejection. The answer to the invitation is delayed and produces a non-contiguous invitation-rejection adjacency pair. Sacks (1987) argued that prefacing and delays in dispreferred social actions, such as disagreement and rejections, make visible to the preference for agreement. Previous empirical studies have shown that turns are generally designed to maximize agreement, minimize disagreement, and maintain contiguity (Drew, 2013; Pomerantz, 1984). Social actors use a range of practices, such as delays and silences that signal to other speakers that disagreement is looming (see Table 14). Disagreements are typically pre-faced and pushed further down in sequences of talk and are subsequently non-contiguous (Sacks, 1987). As such, disagreements sequences are produced as non-contiguous units and social actors use various interactional strategies that increase the projectability of the ‘trouble’ ahead.

The third aspect of social interaction that shapes conduct in disagreement is participants’ orientation to politeness. Brown and Levinson (1987) argued that “…’ways of putting things’, or simply language usage, are part of the very stuff that social relationships are made of” (p. 55). Importantly, they theorized that social actors actively work to manage relational dynamics using a range of interactional politeness strategies. Central to their theory is Goffman’s (1967) notion of face. Goffman (1967) defined face as “the positive social value a person effectively claims for himself by the line [of action] others assume he has taken during a particular contact” (p. 5). Said another way, face describes both the social worth an actor claims as evidenced by the courses of actions they take and how these claims are interpreted by others within social interactions. For example, an actor may claim to be a fair person (claim to social worth) that is then enacted by being fair (evidencing action). The claim could then be recognized and validated by other social actors, as evidenced by their interpretations and responding action (e.g., praising them as a fair person). In this example, face is maintained by the alignment between claims to social worth, actions, and social recognition. Face can either be given (i.e., actions confers increased dignity or social worth), maintained, or lost (i.e., actions that are degrading or confer shame) (Goffman, 1967).

Brown and Levinson (1987) theorized that social actors demonstrate a strong concern for managing face in interaction. Further, they suggested that politeness practices offer social actors a range of interactional strategies to minimize or reduce threats to face in disagreements, rejections, and other face-threatening actions. Practices such as hedges, agreement tokens, apologies, and other mitigation markers (see Table 14), they argued, ultimately work to counteract the potential for damage that can be incurred by disagreements, for example, and can signal to others that threats to face are not intended or desired (Brown & Levinson, 1987). Thus, interwoven in the production of disagreements is the management of threats to face and social solidarity through various interactional politeness strategies.

Interactional contexts and culture also play important roles in whether disagreements are encouraged or discouraged. Previous studies have indicated that disagreements were encouraged in gifted classrooms to promote learning (e.g., Netz, 2014), common within certain cultural communities (e.g., Schiffrin, 1984), and dependent upon the relational dynamics of interactants (e.g., Romera, 2018). Siafianou (2012) argued that disagreement should not be treated as an inherently dispreferred action, but instead conceived of contingent upon culture and interactional contexts. From the findings in the previous chapter, participants' orientations to institutionality and interactional contexts played significant roles in how disagreements were produced and managed in each group. The three groups were characterized by *participants' rights* and *orientation to disagreement*. Weaker, more delicate disagreements were observed in the teacher-centered, STEMU group. Participants in this group had few opportunities and asymmetry in privileges for opening and closing disagreements. The BME and WOM interactions demonstrated less asymmetry in rights, with key differences in orientation to disagreement. The WOM group demonstrated a strong orientation to affiliation at the expense of uncontested and contested forms of disagreements. Comparatively, participants in the BME group engaged in high rates of uncontested and contested forms of disagreement. These interactional contexts ultimately shaped how each form of disagreement unfolded in each meeting.

Below I present the analysis of the sequential and categorical organizations of disagreement. I identified two practices that connected sequence and category for the performance of disagreements. The first practice was *categorial linking*. Categorial linking describes the practice of using a category or categorization from prior talk to construct a disagreement to mark the specific point with which the speaker disagrees with. It was evident that participants used categorial linking to make their disagreements intelligible and recognizable as such. Categorial linking provides a solution to the disruption of the preference for contiguity that occurs in the performance of disagreements (Sacks, 1987). The second observation was that disagreements performed *recategorizations* or *resistances to categorizations*. Resistances and recategorizations are types of category-occasioned transformations (Jayyusi, 1984), a reorganization of membership categorizations (e.g., activities, predicates) that is occasioned for and relevant to the action (i.e., disagreement) at hand. A disagreement in this study would often include an explanation or justification that produced categorizations that were alternative to those from the prior talk. This finding makes visible the varied ways in which social actors construct and negotiate competing versions of the social world in the midst of the production of particular social actions. With this analysis, I argue that social actors track categories, turn-by-turn, in interaction and demonstrate a sequence-category entanglement in the production and management of disagreements. A caveat: given that the current analysis is focused on the sequential and categorial organizations of disagreements, the discussion below is necessarily limited in scope and glosses over other interesting phenomena that appear in the excerpts.

***Section I: Uncontested Disagreements***

*Uncontested disagreements* are disagreements that are acknowledged and resolved or moved beyond quickly. Sacks (1987) argued that speakers seek to end disagreements as quickly as possible and reach a 'mutual understanding'. As such, he suggested, that the preference for agreement in social interaction was evidenced in the practices used to work toward compromise in disagreement quickly. Uncontested disagreement made up 63.7% of the disagreements identified in this study. These disagreements occurred in response to various actions and activities, such as discussion of evidence-based research, sharing ideas or suggestions for practice, and sharing opinions. This form of disagreement occurred in all three groups, though varied in how they unfolded within each interactional context.

The first excerpt provides an illustrative example of disagreement following a participant sharing a suggestion in the STEMU group. The normative interactional mode of this group was chains of Initiation-Response-Evaluation (IRE) (Mehan, 1979) sequences with instructor-controlled turn-taking. Prior to the disagreement, participants were engaged in small group discussions about how to motivate students. A member of a small group raised a question about whether they could actually motivate students who were learning the Krebs cycle and described that topic as difficult to make relatable for students. The instructor then invited other students to share suggestions for motivating students. Portions of the excerpt are bolded and colored purple to draw attention to specific sections of the talk most relevant to the analytical discussion.

*Excerpt #1: 16:10:19.1:STEMU:27:40*

TAB: something that I've (.) realized in all of the
**science classes that I've been in (.) is that no**
**one ever smiles↓**

GRP: [((group laughter and ahhs))]

**TAB: [like I haven't had a biology] professor or**
**chemistry professor who smiles like you walk in**
and it's like hi start of organic chemistry
here's the benzene ring >blah blah blah< ya know
(.) and I've taken I'm not a musician and I
don't know the first thing about music but I
went to I had to take it for college to graduate
a history of western music class and the teacher
smiled (.) and she let me know it was totally
okay to not know the difference between a cello
and a bass

GRP: [((group laughter))]

TAB: [but(.)but] ya know (.) that I (.)could learn↑=

CAR: =yeah=

TAB: =like and that was the most important thing that
was just so motivating to me that (.) there was
this (.) belief (.) from the teacher that I
could do it↓ (.) and sometimes even if something
sounds boring↓ (.) if the teacher's excited
about it or a teacher shows a belief in a
student↑ or the instructor then that in and of
itself can be motivating beyond something that
you think is gonna not (.) be interesting↓=

CAR: =absolutely (.) absolutely I I think that's a
really good point uh I (.) looking back on that
I think I've experienced that quite a bit as
well (.) um but I think (.) I really hope that
we're gonna get to talk about this later and I'm
talking to Rema about it but that's kind of a
growth mindset idea that I'd like to talk to you

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more about how to foster a growth mindset where
it’s possible to achieve these things that we’re
doing and so I’m glad that you brought that up
(.) um Sachika ((selects next speaker))
```

The first selected speaker, Tabitha, initiated a storytelling sequence by offering a complaint about science professors not smiling (Line 1-3). This talk performed humor by producing a category activity ‘puzzle’, combining the ‘science professor’ with ‘smile’, which was treated as an unexpected combination as evidenced group laughter (Line 5). Laughter can also be an affiliative response to a complaint (Stivers, 2008; Vöge, 2010). Lines 1-3 also functioned as a set-up for the forthcoming story and allowed for the continuation of Tabitha’s turn.

At least three membership categorization devices (MCD) were constructed within this story. First, is the ‘science classroom’. This MCD included the student-professor standard relational pair and emphasis was placed on the role of the professors for motivating students. Category-bound activities assigned to the science, or more specifically, biology and chemistry professors, were not smiling (Lines 2-3, 7-8) and introducing boring topics (Line 9-10). The second MCD, ‘music classroom’, produced a compelling contrast. The standard relational pairs in the ‘music classroom’ were student-teacher or student-instructor, compared to the student-professor pair in the ‘science classroom’ MCD. The category-bound activities assigned to the music teacher or instructor were smiling, ‘being okay with students to not knowing content’, and ‘expressing a belief in student’s ability to learn’ (Lines 15-27). The category predicates tied to the music teacher were motivating and understanding. Given the sequence of the construction of the ‘science classroom’ and ‘music classroom’ MCDs, the two could be heard as opposites. This hearing would then add to the science professors, two category-bound activities: lack belief in students and not okay with students misunderstanding course topics. The contrast with the music teacher or professor also implied two category-tied predicates for science professor: not motivating and not understanding. Carrie, the instructor, performed a third-position evaluation that validated and legitimized Tabitha’s story, and also tied it to the curricular goals of the group (Lines 35-42). Carrie’s talk also marked the prior talk as appropriate and unproblematic.

A second speaker, Sachika, was selected and added to the construction of the ‘motivating teacher’ someone who had “a sense of humor”, demonstrated fallibility, and was supportive and empathetic (“I’ve been in your shoes)” (Lines 54-55). A vague description of the kind of “attitude” of science was constructed as a normative feature of science classrooms and labs (Line 47-48) and, given the sequential position, could be heard as an “attitude” that lacks smiling faces, understanding, and belief in students from science professors.

*Excerpt #1 cont.*

SAC: so I think uh what everyone’s been saying is
that in general there’s that kind of attitude in
science in labs as well (.) so I’ve seen what
helps with the students and (in the maker space)
if you keep a sense of humor there↑

CAR: mm hm

SAC: and be supportive and I always tell them that
I’ve been in your shoes↑ (.) and I think that
motivates them because they see us as (.) this
perfect person whose doing everything right (.)
and just telling them ya know I make mistakes
too (some constant human) being you will learn
one day that helps me motivate them like they
make (unless sometimes a drastic)

GRP: ((group laughter overlapping talk))

CAR: definitely I think normalizing mistakes is part
of the practice right it’s so important to make
those mistakes and learn from this

By this point, Tabitha and Sachika co-constructed a version of an instructor who was motivating because of their assigned category-tied predicates: smiling, sense of humor, empathetic, and supportive. The agreement between Tabitha and Sachika produced both *acceptance of prior categorization* and *expansion* of the ‘motivating teacher’ MCD. The co-categorization positioned science professors and the “attitude in science” in contrast to the motivating, music teacher constructed in Tabitha’s story. Categorized this way, then, the ‘motivating instructor’ was treated as a counterculture to the normative “attitude” of science. This implies that to be ‘motivating instructor’ advance education reform, participants would be required to act outside of the mainstream culture of science.

Following Tabitha and Sachika’s suggestions, the instructor selected the next speaker, Keelie, who offered a disagreement.

*Excerpt #1 cont.*

**CAR: yes um Keelie ((selects next speaker))**

**KEE: yeah I just wanted to point out I like all of**
**these comments so this isn’t like a push back**
**but I think it’s important to separate out**
**motivating from necessarily being a certain**
**personality type though↑=**

CAR: =yeah

**KEE: um and if (.) this is not against your comment**
**(.)people may smile less (.) but still be good**
**motivators (.) so just to make sure that we**
**don’t get this stereotype in our head that we**
**have to be a certain kind of personality to be a**
**good motivator or good teacher=**

CAR: =most definitely I’m really glad that you
brought that up because that goes back to
identity right you teach to your strengths what
is your personality and how do you bring that
into the classroom that is a very good
point thank you for bringing that up (.) **alright**
**awesome so now((moves on with lesson))**

The disagreement began with Keelie announcing what they were doing (Lines 70). This first part of Keelie's turn accounted for the fact that the talk that would follow would neither follow suit with what the previous speakers contributed nor would it align with the expected responses to the instructor's initial question. Next, Keelie prefaced the disagreement with politeness tokens, a compliment and a disclaimer, which primed recipients for utterances that could be heard as offensive. The disagreement was further marked by rising intonation on "though" (Lines 73-74) (Goodwin, 1983). The prosodic features produced the talk as hearably incomplete and extended Keelie's turn to allow space to provide a justification or explanation for the disagreement.

In this excerpt, the initial 'motivating teacher' categorization was resisted through Keelie's disagreement. Keelie offered an alternative categorization: a person who "may smile less" and is still able to motivate students (Lines 79-80). The justification simultaneously disrupted the prior categorization and accounted for the disagreement. Keelie's talk categorically linked the "smile" from Tabitha's story to the specific point of disagreement. This offered Keelie an interactional strategy to indicate that the disagreement was indeed in response to Tabitha's comments given the delay and non-contiguous production of the disagreement. This was further evidenced by Keelie's prefacing statement, "this is not against your comments" (Line 78), which implied that the disagreement was referencing Tabitha's comments specifically. This second preface may have served as an interactional politeness strategy to convey that threats to face were not intended or desired.

Further, Keelie linguistically marked the prior categorization as a "stereotype" (Lines 80-82). This could be heard as a critique of the version of the 'motivating teaching' co-produced by Tabitha, Sachika, and the instructor. Brown and Levinson (1987) suggested that speakers often soften disagreements or critiques by linguistically marking shared group memberships. In this

example, Keelie's talk shifted from singular (e.g., "I", "you") to inclusive pronouns (e.g., "we" and "our") near the possible critique (Lines, 78-83). In Rees-Miller's (2000) study of disagreement, it was found that professors often used inclusive pronouns in disagreements in university classroom settings. They argued that this politeness strategy includes students in the instructor's in-group category and, therefore, allowed power differentials to be minimized. Rees-Miller also observed that this strategy was not frequently used by students nor was it necessarily beneficial to do so. The author explained what when a student uses "our" and "we", as was done in this case, it includes the instructor in the student in-group and involves a risk of insulting a professor's knowledge and skills that are conferred by their institutional role. Given the prior categorization by peers, the third-position evaluation by the instructor, and the use of inclusive pronouns, Keelie's disagreement was necessarily tied to talk from Tabitha and the instructor.
In response to the disagreement, the instructor acknowledged, thank, and validated Keelie's comments (Lines 85-86). Additionally, as was done with Tabitha, the instructor tied Keelie's comments to the prior curriculum (Line 88-89). The instructor's talk marked Keelie's disagreement as legitimate and relevant to the institutional goals of the group. The instructor then moved to the next topic and functionally closed the disagreement sequence (Lines 90-91). No further comments were invited and the IRE sequence was re-started.

In this excerpt, the disagreement sequence was constrained because turns were allocated by the instructor. Keelie's disagreement was conditionally relevant after Tabitha's turn, but the instructor selected a different speaker. Keelie used a turn that was tasked for offering a suggestion for motivating students to instead offer a disagreement that functioned as a critique of the "stereotype" of the 'motivating teacher' co-produced by prior speakers. Whereas an agreement between Tabitha and Sachika produced *acceptance* and *expansion* of the 'motivating teacher' MCD, Keelie's disagreement produced *resistance* and *disruption* of the prior categorization. Each category-occasion transformation (Jayyusi, 1984) was specific to the action (i.e., agreement or disagreement) being performed. Additionally, the instructor in this group had privileged rights to opening, maintaining, and closing disagreements. In this excerpt, Carrie's used third-position evaluations to both legitimize students' comments and tied them to the curriculum of the group. This made for complex interactional circumstances for disagreement, wherein a disagreeing speaker needed to be invited to speak, be selected, and potentially disagree with an instructor. Categorial linking was a useful interactional strategy for at least two reasons. First, it linked the disagreement to a specific peer comment that was far from the point with which Keelie's disagreed. Doing this improved the intelligibility of the disagreement. Categorial linking could also minimize implied insults to the instructor by assigning the disagreement to peer comments. The linking that occurred in this example demonstrated the intricate work participants do to managing relational dynamics while presenting disagreements.

The second example of an uncontested disagreement is from the WOM group. This group demonstrated a strong orientation to affiliation and group cohesion, so uncontested (and contested) disagreements were rare. The uncontested disagreement below was in response to an assessment offered by Jenny, one of the peer leaders of the group. In EMCA traditions, assessments refer to evaluative statements about topics of discussion (Pomerantz, 1984). Assessments are common in conversation and a product of social activity. Pomerantz suggested that an assessment is also a claim to sufficient knowledge about that which a speaker is assessing. In other words, when a speaker makes an evaluative statement they also imply sufficient grounds to knowledge about what is being evaluated. In general, when an assessment is offered, as second assessment – either in agreement or disagreement – is offered in response.

In the following excerpt, Jenny produced an assessment that another speaker, Melissa, disagreed with: “it’s really hard to not just lecture at people” (Lines 9-10).

*Excerpt #2: 17:10:17:WOM:59:27*

((peer leader is discussing a future guest speaker))
JEN: she's going to come in and talk about her
experience as a woman in science↑ (.) and then
how she also(.) ↑**teaching strategies she can do**
**on a very large↓ scale↓=**

GRM: =[mm]

JEN: **[cuz] those big classrooms it's really hard to**
**(.) not just lecture at people=**

GRM: =mm hm=

JEN: =so (.) we'll see what she has to say and >then
we can< come back to this as well=

**MEL: =I think think that's a lot of the (.) like**
**everybody says it's really hard to do this on a**
**large scale↑**

**JEN: [yeah]**

**MEL: [but I] think that's from within because like**
**Brenda Coleman is another biology professor (.)**
**who does this(.) think-pair-share things (.) to**
**a large audience↑ and they just clicker**

GRM: [mm]

**MEL: [and] so it's clicker (.) think-pair-share (.)**
**clicker=**

JEN: =yeah

**MEL: if we still don’t get it we’ll think-pair share**
**one more time and she’s like (.) it’s chaos (.)**
**but it’s beautiful chaos**

GRP: [((group laughter))]

**JEN: [exactly]**

**MEL: [and so I] think some of that is just our**
**hesitance (.) to: (.) pull in**

GRM: [mm hm]

**MEL: [but I] think technology is making it a lot**
**easier=**

**JEN: =[yeah]**

**MEL: [to] do whatever you want in the classroom=**

**JEN: =yeah=**

KIM: =I was gonna suggest that if (.) you if you
haven't heard of him Eric Mazur he's a physicist
and at Harvard he's at Harvard physicist slash
professor at Harvard and he is extremely dynamic
at getting students interactive in a physics
classroom ((followed by peers providing
additional examples that support the
disagreeing point and no subsequent
disagreements))

In comparison to the example from the STEMU group, the peer facilitator did not manage turn-taking. Therefore, members of the WOM group had more opportunities and flexibility to offer disagreements. Melissa prefaced the disagreement with an abandoned turn construction unit that was initiating sharing opinion ("I think", Line 17) and produced a report of what "everybody says" (Lines 18-19) that was in agreement with Jenny's assessment. This functioned to place distance between speakers involved in the disagreement by reassigning the disagreement with "everybody", rather than with Jenny's in particular. Jenny responded with a lexical item ("yeah", line 20) that functioned as acknowledgment of Melissa's initial agreement. Melissa used the categorization, "really hard" (Line 17-19), from Jenny's prior talk to initiate the disagreement sequence. By using this categorization, Melissa produced a categorial link between Jenny's assessment and her forthcoming disagreement, which was projectable from the rising intonation on the end of “large scale” (Line 19). This talk also constructed the set up for a forthcoming story. In Lines 23-55, Melissa, Jenny, and other group members co-constructed a story of an example active-learning strategy facilitated in a large classroom. Previous EMCA studies have shown that speakers often use stories to ground their claims or beliefs (Myers, 1998; Mandelbaum, 2013; Warren, 2016). In this case, the story of a biology professor’s use of non-lecture teaching strategies provided both justification and the knowledge basis for Melissa to disagree with Jenny’s assessment. Peers also entered the conversation to offer support for Melissa’s disagreement (Lines 57-65), which further minimized the possibility for maintaining the disagreement and the original claim: it’s difficult to not just lecture at people.

The MCD central to this disagreement was the ‘large classroom’. The category-bound activity that was being contested was the kind of teaching practice (i.e., lecture versus non-lecture) that was possible in large classrooms. In Jenny’s assessment, lecturing was constructed as the normative category-bound practice that occurs in large classrooms, marking non-lecture practices as inherently difficult. In Melissa’s disagreement, Jenny’s categorization was resisted and the ‘large classroom’ MCD was expanded to include additional category-bound activities: think-pair-share and clicker activities (Lines 30-31). Melissa then relocated the source of difficulty for implementing non-lecture teaching practices from the class size to “from within” and “our hesitance” (Lines 43-44). This talk assigned blame to instructors rather than class size while maintaining politeness with linguistic markers of in-group membership. Melissa also transformed the category-tied predicates “chaos,” a potentially partial agreement with Jenny, to “beautiful chaos,” an unexpected combination that produced group laughter (Lines 36-37). Prior studies of disagreement have shown that humor is a common politeness strategy in disagreement and can signal horizontal, non-hierarchical relationships (Habib, 2008; Rees-Miller, 2000). The disagreement was further solidified with Melissa's claim that technology allows you to do "whatever you want" (Line 42-58). This is a clear example of an instance when a participant used a disagreement to broaden the scope of possibilities for practice in keeping with the institutional goal of STEM graduate student teaching development.

The final excerpt in this section is an example of strong uncontested disagreement in the BME group. This example demonstrates the groups' normative capacity for and strong orientation to disagreement. Before this point, participants were discussing an article about making accommodations for students with disabilities. The discussion leader, Mason, asked group members about whether they felt prepared or confident about teaching disabled students, as well as the approaches they would take to accommodate students with disabilities.

*Excerpt #3 5:12:19:BME:10:31*

```
ELL:     so (.) I guess I'll just keep the ball
         rolling here um I don't necessarily think that
         I would change↑ much of anything unless I was
         approached↑ by somebody who had concerns so
         for example (.) um I worked with several
         students who have colorblindness and so they
         have some trouble using some virtual
         technology (.) just because ya know you need
         to be able to see ya know the blood vessel and
         whether its red or blue↑ is gonna determine
         whether it's an artery or vein↓ and so they
         needed additional um assistance but if I guess
         if it's not brought up to me↑ there's not that
         I would do differently I would just try to
         make it so that it's something pretty much
         everybody would be able to see so >ya know<
         big font uh not to many garish colors

MAS:     =mm hm

ELL:     um I think those those are really the big
         ones that I'm normally aware of

LEO:     I mean the sort of the idea behind universal
         design principles is it's (1.0) setting up
```

**your course so essentially hopefully a student**
**would never have to declare a disability=**

MAS: =right=

LEO: =that the course works for everyone↓ I mean
it’s it’s hard (.) um with MEDSCI (0.5) I I
**tried to make some changes** because we get the:
(.) on edge students um we get these students
in ANATOMY in general (.) uh and it’s a lot
about changing the course so it manages (.)
stress↑ a little bit better (.) because they
are so worked up and then we add a lot on top
of it we don’t necessarily need to (.) like
(.)quizzes (.) pop quizzes (.) uh who cares
(.)either they’re gonna show up or they’re not
gonna show up uh- if they wanna practice they
wanna practice at some point (.) we’re adding
too much extra stress (.) for >so little<
outcome um (.) with MEDSCI (.) um (.)I made
things as flexible as possible for attendance↑
because I know that can be an issue but
especially teaching on a Friday (.) um did I
have people not fully understand it (.) yeah
essentially I got four get out of jail free
cards (.) and since they would still have to
do something they could recover their
attendance participation points because it
meets only once a week um >but it was
something< that (.) ya know if they woke up
(.) and they felt like shit and >didn’t wanna
come in< (.) they didn’t freak I didn’t get as
many panic emails of (.) >>oh my god I can’t
come in here’s my doctor’s excuse here’s the
obituary here’s all of this work I’ve done but
like I’m still sick and I’m not getting
better<< (.) like (.) that’s not the point
here

MAS: mm hm

LEO: uh so it did work in that (.) where they’re
just (.) not used to having to not justify (.)
their own illness which (.) is fucking other
bullshit (.) on many levels so

**MAS: so a question then to follow up I’m glad you**

**brought up MEDSCI so for yourself for Kimberly for Donovan if you have anything to add um the Rickets article talks about the outcomes for MCQ tests for med students they seem to do as well as other students**((continues and topic transition and no subsequent disagreements related to this point))

Ella responded to the discussion leader's question with a story about making accommodations for a disabled student. In this story, 'disabled student' MCD was constructed as someone with colorblindness, which interfered with their ability to learn using color-based curricular materials. The accommodations (category-bound activity) were tied only to course materials that were inaccessible and limited learning for a specific disability (Lines 6-12). At line 24, Leonard initiated a strong, unmitigated, unambiguous disagreement sequence. Prior taxonomies of disagreement would categorize this example as direct or grounded (Blum et al., 2002) and aggravated (Goodwin, 1983), given the near absence of mitigation or politeness markers. Compared to the two excerpts above, Leonard's talk did not use categories from the prior speaker's talk to initiate the disagreement. In other words, it was *categorically unlinked*. One possible explanation for the absence of categorial linking was that the disagreement was strong and direct enough that the link was not required. However, as we will see below, categorial linking was present in contested, stronger forms of disagreement in this study. Another explanation for the absence of categorial linking was that this is a deviant, non-normative practice. Only three disagreement points (2.4%) in this study were categorial unlinked. The second instance, described in Section IV, was deviant in both sequential and, arguably, categorical ways. I suggest that the example above was sequentially normative, but categorial deviant.

The strength of the disagreement was continued with Leonard's story of accommodations in an undergraduate medical science course. The 'disabled student' MCD was modified and used to describe “on edge” students (Lines 34). Further, the students were positioned as the norm (“we get these students…in general”, Line 33-36), not the exception as was done in Ella’s example. The category-bound activity, making accommodations, was contested and transformed in this disagreement. Instead of making a single accommodate relevant to one particular type of disability, Leonard’s story constructed several practices, such as flexible attendance and not requiring justifications for conditions, so that the entire course would “manage stress” (Lines, 36-37) for students. The responsibility or source of the problem was also reassigned from the students’ disability to the instructors’ practice (Lines 43-45). Similar to the previous excerpts, Leonard used “we” to mark shared group membership, a politeness strategy that may have worked to maintain a shared sense of responsibility for the problem. Leonard produced a strongly negative assessment about justifying disability, “which is fucking other bullshit on many levels” (Lines 67-70), which upgraded the disagreement with Ella’s original suggestion. Together, the category-occasioned transformation, a story of practice, and strong negative assessment at the end could have contributed to Leonard’s talk being heard as a legitimate critique. Leonard’s disagreement also offered an example of an alternative strategy for instructors to implement evidence-based teaching practices.

A few key features of this interactional context may have contributed to how this disagreement unfolded. First, the shared rights to self-selection for turns allowed Leonard to offer a disagreement and critique where it was most conditionally relevant. As discussed in Chapter 5, shared rights to turn-taking was a core feature of this group, thus, opportunities for initiating disagreements were not as constrained as the STEMU group. In this example, the discussion leader acknowledged the disagreement and invited others to contribute (Lines 72-74) rather than completely ending the disagreement as was done in Excerpt 1. Despite the invitation to contribute to the disagreement, peers changed topics and oriented to the discussion leader's talk as the end of that particular disagreement sequence. One possible explanation for ending the disagreement quickly was the strength of it. Reopening the disagreement would require a speaker to push back against a strong negative assessment (Line 69-70) tied to a potential moral dilemma: *should* students have to justify their need for accommodations? The risk of being viewed as unsupportive or unwilling to make accommodations for students with a range of disabilities was high. Thus, given potential threats to face looming, it is not surprising that a topic shift occurred and the disagreement ended quickly.

***Summary of the Analysis of Uncontested Disagreements.*** Uncontested disagreements were the most common form in the study. The purpose of this analysis was to identify common practices or discursive features that lead to quickly ending disagreement. Here I summarize the patterns of features of uncontested disagreement based on the analysis above and consider what made quick endings possible.

The interactional and discursive features of uncontested disagreements varied across the groups. Uncontested disagreements can be weak (indirect, mitigated, Excerpts 1 and 2) or strong (direct, aggravated, Excerpt 3) and served various purposes. Importantly, all three disagreements functioned as critiques of conventional approaches to education and broadened the scope of possibilities for motivating students and evidence-based teaching practice. Each example included some distancing practices, shifts from singular to inclusive pronouns, and other politeness practices (e.g., prefacing). Thus, it was evident that participants used a range of politeness strategies to manage threats to face in uncontested disagreement whether they were weak or strong. The sequential location of uncontested disagreements was largely dependent upon participants' rights to turn-taking. In the WOM and BME groups that were characterized by shared rights to turn-taking, uncontested disagreements occurred when they were conditionally relevant. Whereas relevant disagreements in the STEMU group were typically delayed due to limited opportunities for being selected to take turns. To deal with this, a speaker could use their turn for a different purpose than what was requested or expected. Categorial linking, thus, provided an effective interactional strategy to increase the intelligibility of disagreements that were likely delayed or indirect.

Additionally, storytelling was a common practice that participants used to offer justifications or explanations for their disagreements. The stories achieved multiple ends for speakers. Stories produced alternative categorizations and, thereby, resisted or transformed prior categorizations. Stories also provided the knowledge basis for the disagreement. Since the stories were either based on personal experience (e.g., Excerpt 3) or reports of someone else's practice (e.g., Excerpt 2), the knowledge base was treated as sufficient enough to legitimize disagreeing points and (potentially) end the disagreement quickly. The stories in Excerpts 2 and 3 included upgrades that intensified the disagreements. In Excerpt 2, the story led to additional stories that provided support for the disagreement. The negative assessment at the end of Excerpt 3 intensified the disagreement and introduced a moral dilemma. Thus, additional support from peers and moral dilemmas may have served as barriers to continuing disagreements.

The endings of uncontested disagreements provided important insights into how participants were able to end them quickly. Instructors, discussion leaders, and peers also played a significant role in ending disagreement sequences or moving on. In Excerpts 1 and 3, the group leader marked the end of the disagreement by moving on to a different task. Students did not re-open the disagreement sequence, thus, moving on was treated as the end. Instructors in the STEMU group also had privileged rights to introducing and, therefore, re-opening or continuing disagreements was highly constrained for students in this group. The discussion leader in the BME group, by contrast, invited speakers by name (Excerpt 3). The invited speakers did not contribute and, thus, oriented to the discussion leaders' talk as the end of the disagreement. In Excerpt 2, peers offered examples of practice in support of disagreement. These reports functionally marked the end of the disagreement and led to a transition in topics. In all cases, the ends of uncontested disagreement sequences were collaboratively produced and explanations (i.e., through stories) were treated as legitimate enough to warrant moving on.

***Section II: Contested Disagreements***

In the section above, I described disagreements that ended quickly and without rebuttals. Contested disagreement, by contrast, are disagreements that are continued and include back-and-forth disputes. The analytical question that guided this section of analysis was: *how do disagreements keep going?* Specifically, I was interested in identifying patterns across the practices social actors used to maintain disagreement and the role of categories in doing so. The underlying logic of this is that if disagreements are dispreferred yet they continue, social actors must use special practices for maintaining them and, eventually, ending them. Contested disagreement sometimes included sequences of clustered disagreements where one person offers a disagreement then similar disagreements are introduced by other participants. The disagreements often started out weaker and then were upgraded and subsequently increased threats to face. After back-and-forth exchanges, these disagreements were either redirected, diffused, or mediated by third parties. 37 (29.1%) of the disagreements points in this study were contested. This form of disagreement also varied significantly by interactional context.

The first example of contested is from the WOM group. Six disagreeing points in this group led to contested disagreements, representing roughly one-third of the total disagreements for this group. The contested disagreements typically occurred after a speaker shared an opinion or suggestion related to evidence-based educational practices. Prior to the exchange in Excerpt #4, one of the peer leaders (Francesca), shared an evidenced-based, multiple mentor network model for mentoring relationships. Group members responded by self-selecting turns to offer opinions or ideas about how they would use mentor network mapping with their students. Michal offered the first idea.

*Excerpt #4: 17:10:17:WOM:48:53*

MIC: I really like the idea and will (.) probably
take a blank one of these to use with students
that I↑ mentor↑ (.) because I like the idea
**of(.) going into a mentoring↑ relationship↑ (.)**
**thinking about these↑ needs↑ (.) filling out and**
**noticing where there are gaps↑=**

GRM: =mm hm=

MIC: =in it (.) >so this is something< I'd probably
asked my student to do (.) privately↑ (.) like I
would meet with them (.) tell them (.) I will do
these things↑ (.) you should make sure that (.)
ya know on your own time >if it's not something
you wanna share with me↑ that's okay↑<(.) you
should make sure that you have (.) two people
per (.)thing (.)at least right↑ and if you don't
then that's something we should talk about so
that I can help you make some more connections
>cuz I work with a lot of< REU students who are
only here for the summer who don't >know anyone
else< except for the handful of people in their
(.) little dorm (.) and I think back hard for
some↑ of them↑(.) so I really like this idea (.)
it's something that I should do for myself but I
always think about these things more in terms of
what I can do for my students

(2.0)

ETI: **yeah >I think in terms of your situation< (.)**
**like (.)it's always like (.) what I would do is**
**(.) if it was like a student coming to me I**

**would hope that they would be like (.) this is**
**what I need (.) you're providing this (.) but**
**(.) there's this other thing I'm being proactive**
**and trying and go get it**

GRM: [mm:]

**ETI: [>but] I know that< (.) not all PIs respond to**
**that (.) um (.) and so however way you can spin**
**it knowing like your PI↑** but (.) being like (.)
always sandwiching it I guess of like you're
doing all this but I also need this and to be
successful at your lab and to give you the final
product that's going to make you look good

GRM: [mm hm]

ETI: [not using] those words like this is what else I
need

GRP: ((group laughter))

The disagreement sequence was initiated when Etienne shared a perspective that was different than what Michal offered (Line 31-37). Specifically, the sequence of two of Etienne's utterances, "yeah in terms of your situation" and "what I would do", discursively constructed a distinction between the two perspectives. Etienne used the categorically linked the disagreement with Michal's comment by using the lexical item, "need", to construct the disagreement where an alternative category (e.g., 'support') could have been offered. A justification or explanation beyond personal opinion was not provided for the disagreement. Compared some of the uncontested disagreements in the previous section, which included stories of practice or evidence of some sort, no external knowledge basis for the disagreement was offered. However, Etienne downgraded and qualified the disagreement by noting that "not all PIs" (Lines 41-43) would respond the way she suggested. This qualification could have provided Etienne the opportunity to save face while also maintaining a stance based on personal opinion. Michal responded to Etienne's disagreement with a rebuttal (Lines 55-74).

*Excerpt #4 cont.*

**MIC: I think it's hard because these expectations get**
**set so early in a mentoring [relationship**↑]

**GRM: [mm hm]**

**MIC: and like being (.) a new REU student (.) um or a**
**new lab tech or new grad student (.) you're not**
**going in as I need this (.) you're going in as**
**I'm an employed person here's what I [can do]**

**GRM: [mm]**

**MIC: these sort of things come later**↑ (.) **>and that's**
**not necessarily< right (.) but (.) you're trying**
**to do that impression (.) not come across as**
**being needy**

GRM: [mm hm]

MIC: [um so]

**ETI: [>well I] think the challenging part with**
**that too< (.) I've been thinking about a lot**
**this week in my (.) situation**↑ is that like you
don't always know >how the relationship is gonna
[develop<]

GRM: [yeah]

ETI: [and so] like in retrospect I think my lab is
like a generally positive place my PI is like
(.) not a terrible person and if I'd come in and
**knowing what I know now (.) and said like this**
**is what I need (.) then I would've done things**
**differently right**↑ **but (.) >I didn't know< that**
**like he wasn't gonna provide certain things**

GRM: [mm]

ETI: [and] I didn't know (.) how uh during my
fourth year I was gonna I feel like I do now=

GRM: =mm hm=

ETI: and so I guess (.) like (.) I'm trying to think

about it in both as a mentor and as a mentee
like how you ensure to keep it flexible

GRP: [mm hm]

ETI: [because] like that relationship changes

GRM: mm hm

**AMB: yeah >going off of that< I don't know what**
**it's like in other fields but I've changed my**
**committee a lot**

Michal's rebuttal began with a vague, hearably incomplete negative assessment marked by the rising intonation at the end of "mentoring relationship" (Line 56). Given the sequential location, "I think it's hard" could be heard as the beginning of a disagreement with Etienne's point of view. Michal then produced a three-part list (Lines 60-63) with different institutional identities for possible standardized relational pairs (e.g., mentor-lab tech) involved in a mentoring relationship. What is particularly interesting about this discursive move is that it broadened the applicability of Michal's stance to a wider set of role relationships. Jefferson (1990) argued that participants may use three-part lists to produce "no argument" utterances in an effort to resolve or minimize disputes. In other words, including three roles instead of one decreased the likelihood that another speaker would take exception with what was offered.

Michal then negatively assessed Etienne's prior talk (i.e., "not come across as needy") (Lines 67-70). This assessment recategorized Etienne's "proactive" approach to the mentoring relationship as one wherein the "employed person" (i.e., REU student, lab tech, or grad student) could run the risk being interpreted as "needy." Overlap occurred between the two speakers talk as Michal continued speaking and Etienne initiated rebuttal (Lines, 74-76). Notably, overlapping talk only occurred during contested disagreements in this study. Next, Etienne upgraded the disagreement in a couple of ways. First, Etienne reported that she had thought "a lot" about the topic of discussion (Line 77-78). The report functioned as an epistemic intensifier and performed 'I know what I am talking about.' A second upgrade to the disagreement was that Etienne used a personal experience to validate the original stance. Prior EMCA studies have shown that social actors involved in disputes will sometimes use personal experience as a resource to bolster their defense against attacks on their stance (e.g., Evaldsson, 2005; Whitehead, 2017). A peer, Amber, then entered the conversation and produced a *disaligning action*, a topic shift, which disrupted the continuation of the disagreement. Amber's action was followed by a discussion about how graduate student committees were organized and the disagreement sequence remained closed. To summarize, this contested disagreement occurred in the following sequence:

- *Pre-disagreement*: Speaker A shared an idea
- *Initiation of disagreement sequence*: Speaker B disagreed
- *Extension of the disagreement*: Speaker A offered rebuttal, disagreed with Speaker B, and justified their stance
- *Upgraded disagreement*: Speaker B defended stance, upgraded disagreement, and shared personal experience to justify their stance
- *Disaligning action*: Interjection from a new speaker
- *Disagreement sequence closure and post-disagreement*: Disagreement is not re-opened and speakers moved on to a new activity or action.

The MCD involved in this disagreement was the 'mentoring relationship'. Table 15 outlines differences between Michal and Etienne's categorization of the 'mentoring relationship' based on key concepts for categorial analyses (Sacks, 1972a; 1972n; Stokoe, 2012a). The main categorial tensions are italicized to show differences between the categorizations produced by the two speakers.

Table 15

*Comparing of Membership Categorization Device Construction in Excerpt #4*

| Michal's 'Mentoring Relationship' MCD | Etienne's 'Mentoring Relationship' MCD |
| --- | --- |
| Category-bound activities<br>• *Student privately assesses needs and lists supports*<br>• Mentor tells students what they can offer | Category-bound activities<br>• *Student take a proactive, public approach and expresses needs with mentor*<br>• Mentor tells student what they can offer |
| Standardized relational pairs<br>• *Mentor-REU student*<br>• *Mentor-lab tech*<br>• Mentor-grad student<br>• *Mentor-employed person* | Standardized relational pairs<br>• Mentor-student<br>• PI-grad student |
| Category-tied predicate<br>• Isolated REU student<br>• Private | Category-tied predicate<br>• Proactive<br>• Public<br>• "*needy" (via Michal's rebuttal)* |
| Duplicative organization<br>• REU student, lab tech, grad student | Duplicative organization<br>• PI (i.e., principal investigator and mentor) |
| Positioned categories | Positioned categories |

| | |
|---|---|
| • New adjective to each category, indicating stage-of-career categorization | • Early grad student versus fourth-year, indicating stage-of-career categorization |

The table is not meant to be exhaustive. Instead, it demonstrates that various aspects of categorizations, such as activities and predicates, are negotiated and contested, turn-by-turn through disagreement.

The second example of contested disagreement occurred between a student and an instructor in the STEMU group. The institutional role of instructors conferred privileged rights to solicit, proffer, and end disagreements, which were enacted and oriented to as normative by participants in this classroom setting. Just before this disagreement, the instructor, Rema, contrasted the difference between teacher-centered and student-centered approaches to teaching. The extended exchange is provided in the excerpt, but the analytical discussion below focuses primarily on four bolded portions of the exchange: (1) the actualization of the disagreement (Lines 42-45), (2) the initial response to the disagreement (Lines 66-70), (3) the talk that maintained the disagreement (Lines 145-153), and (4) the actions that followed the exchange (Line 178).

*Excerpt #5: 23:10:19STEMU:13:20*

```
REM:     any questions↑ about that↑↑ (.) yeah ((selects
         next speaker))

ABI:     can I ask (.) I I don’t know that this is a nice
         question

GRP:     ((group laughter))

REM:     did you say nice↑
```

GRP: ((group laughs louder))

ABI: yeah

REM: oh wow (.) okay

ABI: so so so so forgive me for this let's say like
(.) you're teaching elementary school kids and
there's this emphasis on really getting them all
to read because if they can read

REM: yeah

ABI: then they're not then the learning gap is not as
small as they↓

ABI: [get] older [right]

REM: [yeah]

ABI: so I understand (.)

REM: [hm]

ABI: [that] (.) you know (.) like in step two the
determine acceptance of evidence of achievement
you want every kid to be able to read by the
time they leave (.)second grade [for instance]

REM: [mm hm]

**ABI: now (.) when you're teaching students who are**
**trying to get into med medical school (2.0) is**
**it acceptable that not every student is going to**
**achieve(.)the learning↑**

(1.0)

ABI: you know what I mean

REM: mm hm

ABI: like (.) I guess I'm asking like what at what at
what level do you say this is acceptable
evidence of achievements (.) and if a student
doesn't achieve learning (.) is it on you as the
teacher↑ (.) or at some point where do you draw

the line between (.) knowing that you've done
the best job you can do as being a teacher
and that just not every student is going to be
able to pass your class because(.)not every
student's gonna be able to get into med school
[you know what I mean it’s not a nice way to
ask]

First, the disagreement between a student (Abigail) and one of the instructors (Rema) began with a significant amount of prefacing work (Lines 1-38). The prefacing talk included a warning, softened by humor, that the talk was not “nice” (Lines 4-13), an apology (Line 17), and a contrast (e.g., students learning how to read versus getting into medical school) to frame the forthcoming disagreement (Lines 18-45). This talk marked and asymmetry in the rights to questioning the evidence presented in the introduction of student-centered teaching and was indicative of delicacy required for a student to disagree while also minimize the risk of insulting the instructor. The first bolded section of the excerpt was where the disagreement was actualized in lines 42 to 45 as a question: “it acceptable that not every student is going to achieve (.) the learning↑”? The questions could be heard as not “nice” because it was counter to what Rema, the instructor, had previously advocated for in the introduction to student-centered teaching. This disagreement also introduced a moral dilemma about whether all students *should* or can achieve learning.

*Excerpt #5 cont.*

**REM: [yeah (.) no it's a great question] and (.)**
**actually what we're going to do today I think**
**it's going to help us focus↑ because(.) um your**
**(.) goal (.) may not be (.) to get your students**
**into med school**

ABI: [right]

REM: [that] may be the student’s goal (.) right

ABI: right

REM: so when you're designing (.) your learning
outcomes and your goal you design them based on
your goal(.) for your students

ABI: I see

REM: right so your goal may be I want them to love
biology [right]

ABI: [right]

REM: or I want them to have an appreciation for the
scientific method (.) right those are big
learning goals big picture right (.) then we're
going to focus on what are the outcomes (.) what
are students being able to need to be able to do
so that they can show you that they
appreciate

ABI: right right right

REM: biology right and then the evidence (.) actually
(.) is not is not the outcomes (.) the evidence
is how you're going to assess whether the
outcome is achieved(.) so for the your example
about reading (.) it's not the outcome is not
all students (.) read that’s well that's the
outcome but that's not the assessment (.) how
will you know that all students can read a
certain level(.) well you're going to give them
(.) a quiz(.)or you're going to have them
practice (.) with worksheets so they're gonna to
show you or they're gonna to read you and then
you're gonna know that they've achieved a
certain level

ABI: right

REM: so that's the assessment (.) does that make
sense

ABI: yeah=

REM: =so all:: of this is based on what your goal is
for your students (.) so if your students are
not don't do well and aren't achieving those

learning outcomes and they don't get a good grade in their classes it’s because they haven't achieved the outcomes that you set it's not because (.) they haven't you haven't taught them to do well in med school

ABI: right right

REM: to achieve their goal (.) and to go to med school right they might have to readjust if they aren't able to meet those learning outcomes (.) right they might need to think about how they're studying or what it is that's the barrier for them to being able to achieve those outcomes (.) does that make sense does that answer your [question]

ABI: [yeah]

REM: [a little bit]

In the second chunk of bolded text (Lines 65-69), the instructor responded to the disagreement by acknowledging and validating Abigail’s question. The instructor then tied Abigail’s talk to the institutional goal of the group to “focus” the discussion. This, both, marked Abigail’s talk as not aligned with the focus of the group and extended the instructor’s turn. The two were involved in an extended negotiation of the instructors’ and students’ goals (Lines 67-142). The ‘medical school goal’ and was categorically linked throughout the exchange and provided the instructor with a resource for clarifying student-teacher responsibilities in learning relationships.

The third chuck of bolded text is the portion of the exchange where the disagreement was maintained (Lines 143-151).

*Excerpt #5 cont.*

**ABI: [yeah] I think I'm stuck on on how you (.) how you make sure like, what do the students need to learn makes it seem to me that like if the student didn't learn it, it was a failure on your part (.) ya know and that's [my worry]**

**REM: [it's actually]**
**kind of the opposite because it's student**
**centered right** it's focused on well I’m not I'm
not going to say it’s the opposite it's both
right so if you're not aligned we're going to
talk a lot about alignment so if your
assessments are not aligned with your outcomes↑
(.) then the student doesn't do well on the exam
(.) that is on you (.)right because you haven't
aligned your assessments appropriately

ABI: sure

REM: if the student isn't studying properly (.)
and effectively but you have good alignment (.)
then that's on them (.) then you have to help
them learn how to study more effectively (.) so
de- sort of um diagnosing the problem

ABI: right

REM: is where you want to be

ABI: I see

REM: does that make sense↑

**((followed by more contested disagreements))**

Abigail responded to the instructor’s consensus checks (e.g., “does that make sense…a little bit”, Lines 136-141) by reporting being “stuck”, which marked the previous talk as an unsatisfactory solution to the dilemma raised with the initial disagreement. Similar to Excerpt #4, Abigail did not produce a concession or sequence closure and instead reasserted a concern about who is responsible for ensuring that all students learn. Additionally, an if-then (i.e., clausal) utterance produced the potential for an instructor to “fail the student”, to which the facilitator offered a rebuttal that occurred with overlapping talk (Lines 147-149). This negative assessment (i.e., “fail the student”) intensified and, therefore, upgraded Abigail’s disagreement. The instructor’s second rebuttal was also intensified through a more direct utterance and a reassertion of the focus

(Lines 149-158). Despite the striking differences between Excerpts #4 and #5, they have a similar sequence pattern: pre-disagreement, initial disagreement, rebuttal, upgraded disagreement, and eventual disagreement sequence closure.

Following this exchange, several other students offered disagreements. The disagreements were either related or unrelated to the one at hand. This produced a pattern of clustering of disagreements in the STEMU meetings. This was likely because when one speaker introduced a disagreement it provided other speakers with opportunities to introduce conditionally relevant disagreements. In their studies disagreements in peer review board meetings, Raclaw and Ford (2015, 2017) suggested that offering a disagreement after another speaker could also act as a buffer to strong objections and rally support for sides of competing perspectives. The instructor selected three speakers, each of whom offered disagreements that were relevant or unrelated to the disagreement. Eventually, the instructor said “let’s move on” and closed the disagreement sequence.

One of the main categorizations negotiated this disagreement was the ‘goal for learning’ MCD. The MCD constructed the student-instructor standard relational pair with various category-bound activities assigned to each role (e.g., instructors aligning goals and assessments, students studying properly). The categorial aspects of the exchange were involved in the production of (at least) two dilemmas: (1) *should* or can all students learn and (2) who is *responsible*, the student or the instructor, if the learning is not achieved? Thus, disagreements were oriented to by participants as categorial concerns that were negotiated across the sequence. Furthermore, the categories-in-use were occasioned and fitted to the interaction at hand. In this excerpt, the ‘pre-medical student’ was categorically linked across the disagreement sequence. While a ‘pre-medical student’ was likely not the only kind of student in Abigail’s biology class, it was treated as most relevant to the disagreement at hand. Categorial linking the ‘goal for learning’ throughout the disagreement served two possible purposes: (1) it increased the intelligibility and cohesion of the disagreement by connecting non-contiguous units and, thereby, (2) contributed to the progressivity of the talk by not further complicating the disagreement sequence with a challenge to the categories constructed throughout (e.g, ‘pre-medical student’). In other words, the categorial linkage allowed speakers to make disagreements efficiently and end them as quickly as possible.

The third and final example of a contested disagreement is from the BME group. This excerpt illustrates how multiple speakers work collaboratively to construct and manage contested disagreements. The BME group interactions were characterized by participants’ orientations to shared rights to turn-taking and a strong orientation to disagreement. The meetings were organized like a Socratic seminar (Tredway, 1995) and included multiple rounds of questioning and debates about articles related to teaching and learning. *A priori* knowledge that the BME meetings were structured like a Socratic seminar is not sufficient grounds to claim participants’ orientation in EMCA studies, however. The institutional goal to generate a Socratic style discussion was something that the participants could have either oriented to or resisted. Nonetheless, that intellectual debate was part of the planned goal for the meetings that necessarily shaped the expectations for participation. In this case, the participants, more or less, demonstrated that disagreement was acceptable by participating in, at times, intense, contested disagreements.

The BME group produced 26 of the 37 contested disagreements (70%) identified in this study. Additionally, the group consistently engaged in humor whether doing disagreement or other social actions (e.g., complaints, compliments). Previous studies have shown that sometimes humor is used prosocial practice to reduce tensions in disagreement (Raclaw & Ford, 2017; Romera, 2018). Studies have also indicated that the frequent use of humor in social interaction is a possible marker of non-hierarchical relationships between speakers (Habib, 2008; Rees-Miller, 2000). Prior to the exchange below, group members were discussing whether using computed-based, standardized feedback about incorrect responses to multiple-choice questions was a beneficial practice to support student learning. Portions of the excerpt are colored green and purple to represent the simultaneous negotiation of multiple categorizations.

*Excerpt #6: 31:10:19:BME:39:45*

REN: how is that but I don't know but **to just have**
**that written out for them**

MAL: right

REN: [I don't think I don't think]

PHO: [especially if you've only got a half an hour]

NOR: [30 minutes (.) yeah ]

**REN: I don't think that's going to be giving them any**
**more benefit to understanding I think [I think**
**that]**

**DON: [the**
**research] says otherwise↓**

**GRP: ((group laughter))**

**DON: (and I'll say having) written my proposal lately**

**GRP: ((group laughter))**

**DON: [however]**

**REN: [there] there is research that also says that**
**just reading something doesn't do jack shit [for**
**you((laughter))]**

**DON: [but in the] moment (.)providing an explanation**

**32 [((inaudible))]**

The disagreement in this excerpt was in response to Renee's expression of doubt about whether using standardized feedback could be beneficial (Lines 12-14). In Line 16, Donovan initiated the disagreement sequence with a direct, unmitigated assertion. Some contextual information may provide helpful clues for why laughter (Lines 19 and 23) followed Donovan's disagreement absent of the grammatical, prosodic, or syntactic linguistic features that would make the humor in the sequence more visible (to an analyst or reader). In previous meetings, Donovan shared updates about his dissertation proposal writing and the topic was the use of multiple-choice questions. Two of the advisors, Phoebe and Mallory, would sometimes invite Donovan to share key research findings from his proposal that were relevant to discussions in the meetings. Positioning Donovan as the knowledgeable about multiple-choice questions in previous meetings granted Donovan privileged epistemic rights that were likely at play in this exchange. Renee's doubt, then, made relevant Donovan's claims to knowledge about the topic in the service of the disagreement. Donovan vague statement "the research says otherwise" (Lines 16-17) and report of writing a proposal could be heard as stating what 'everybody knows', including Renee. With this context in view, Donovan's disagreement could be heard as ironizing Renee's comments. Hence, other members of the group treated the disagreement as funny.

Renee used "the research" from Donovan's turn to construct a direct, unmitigated rebuttal, which categorically linked the point of disagreement to the rebuttal. This talk produced a challenge to Donovan's epistemic rights and further maintain the disagreement. Next, others in the group contributed to managing the disagreement.

*Excerpt #6 cont.*

**33 ANN: [and well if it's] well written if it's just**
**34 like this is the definition of the thing then no**
**35 [that doesn't really help]**

**DON: [but it could be (helpful)]**

**ANN: we had some for the earlier block like Blocks 1**
**and 2 practice exams on um Canvas they had**
**feedback afterwards (.) and some of the**
**questions and feedback was completely worthless**
**(.) and some of the questions the feedback was**
**really good it was just getting these two things**
**flip flipped switched**

GRM: mm hm

**ANN: but (.) if the feedback isn't good then yeah**
**it's like [it's a stretch if it's not designed**
**(inaudible)]**

REN: [>and I was thinking if it's not< if it's if
it's not personalized] too right so there is
there's a degree of personalization=

ANN: =yeah=

REN: =then maybe the students do benefit from

GRM: yeah

REN: where I think **this is I think that's one I think**
**that's a step I'd say I'm saying like >relating**
**to this specific article<**

GRM: mm hm

REN: would they say that that is moving you toward if
it's not personalized if [it's not]

ANN: [yeah]

PHO: [I don't think it's (.) feasible]

REN: [then I don't know that] in this particular
sense I don't know that it's useful

**REN: I don't think it's moving toward where they were**
**suggesting not saying it has to be this way**

**PHO: it's better than nothing**

**REN: it’s better than nothing I’m just saying relating to this specific to this article I don’t this that takes them all the way to where they are**

ANN: ((shakes head))

GRP: mm hm ((debate continues))

Annabelle entered the conversation and offered a story based on personal experience with receiving personalized feedback about multiple choice question responses (Lines 33-51). Instead of aligning with one side of the argument, Annabelle’s clausal utterance (i.e., if-then) allowed for both stances in the argument to be validated (Lines 49-51). At this point, the disagreement could have ended. Instead, Renee was able to use Annabelle’s story as a resource for justifying (Lines 53-61) and maintaining (Lines 79-87) the disagreement. Additionally, an advisor, Phoebe offered weak support for Donovan’s stance (Lines 82). As discussed in the previous chapter, with Phoebe’s institutional role and rights, weak support against Renee’s argument could have discouraged the maintenance of disagreement. However, Renee worked to make her stance more defensible by referencing a research article and placing boundaries around what research was relevant (i.e., “this specific article”, Lines 64-65, 85) or not (e.g., potentially Donovan’s research) to the disagreement.

This contested disagreement sequence pattern was similar to Excerpts #4 and #5, but included additional expansions (e.g., additional rebuttals). Another key difference was that another speaker, Annabelle, offered support for both sides of the disagreement. This may have been an, albeit unsuccessful, attempt to diffuse the disagreement. It also contributes evidence that the idea that social actors use stories to end disagreements (Myers, 1998; Kjaerbeck, 2008), though this interactional strategy does not always work. Similar to the other two excerpts, categorial linking was a feature of contested disagreement. Even in the case of strong disagreements, categorial linking weaved the points of contention through category-use. In the co-construction of this disagreement, at least five predicates were tied to the 'useful feedback' MCD: (1) not beneficial (Lines 12-13), (2) unhelpful (Line 35), (3) helpful (Line 37), (4) worthless (Line 42), and (5) good (Line 44). The disagreement continued and it was unclear whether 'mutual understanding' about what constituted 'useful feedback' was achieved. By now it should be clear that disagreements are key sites for the negotiation of contingent categorial arrangements.

***Summary of the Analysis of Contested Disagreements.*** The contested disagreements in this study shared a similar sequence pattern:

- *Pre-disagreement*
- *Initiation of the disagreement sequence*
- *Expansion of the disagreement (e.g., rebuttals, counters)*
- *Upgrade of the initial disagreement*
- *Disaligning action (i.e., attempt to derail the course of the disagreement)*
- *Disagreement sequence closure*

The three distinctive features of the contested disagreements are the *expansion*, *upgrade of the initial disagreement*, and the *disaligning action*. To expand the disagreement, speakers must perform another relevant action that requires a response. Without a rebuttal, counter, or comment, the disagreement does not continue. The expanding action must also be one that warrants further discussion. In the examples above, the expanding actions included increased threats to face. In Excerpt #4, for instance, Michal negatively assessed Etienne's talk. A response was necessary for Etienne to defend her stance to save face. By contrast, a downgraded disagreement would likely not warrant the expansion and moving on might be more beneficial to social solidarity. Third, following an expansion of a disagreement, a speaker may either concede or modify their initial disagreement (i.e., downgrade or upgrade). The initial disagreement was upgraded in each contested disagreement. This likely contributed to the progressivity of the disagreement sequence by increasing the risk of face threats that warranted a response. The final component of the contested disagreements sequence pattern was the *disaligning action*. In the excerpts above, speakers would change topics, tell a story, or initiate another action in an attempt to disrupt the progressivity of the disagreement sequence. The disagreements often ended without markers of resolution or evidence of reaching 'mutual understanding'.

The contested disagreements above produced moral dilemmas and raised questions about the implementation of evidence-based practice. In Excerpt #5, Abigail's disagreement raised questions about whether all students can learn and if teachers *should* be responsible for ensuring the learning. Since one of the goals of this instructional change strategy is to convince STEM graduate students and future faculty of their responsibility to create equitable opportunities for learning, this disagreement opened the door for the instructor to persuade Abigail. Others in the room with yet-to-be stated disagreements could also be convinced (or not) by the rationale for student-centered approaches to teaching. Thus, Abigail's disagreement provided an opportunity for persuasion and negotiation of the responsibility to create equitable opportunities for learning. The disagreements in Excerpts #4 and #6 introduced questions about how evidence-based educational practices can be implemented. In both cases, there were competing views about how to implement what the research suggests to support student learning. These disagreements presented (likely missed) opportunities to suggest that there is more than one 'right' way to implement evidence-based teaching and mentoring practices. Though contested disagreements were marked by tensions and face-threats, they generated important dialogue that is critical to the institutional goal of promoting instructional change in STEM disciplines.

The categorial organization in contested disagreements was similar to the other forms of disagreement. Various aspects of the categorial organization (e.g., activities, predicates, and positionings) were negotiated over the course of the disagreement sequence. This negotiation made visible the varied ways in which social actors construct and orient to a particular version of the social world. Furthermore, as noted above, the categorial linking across turns of talk increased the overall cohesion and intelligibility of the disagreement sequences, and maintained the progressivity of the talk. Thus, disagreements in this study illuminated the intersection of practical and sociological sensemaking practices that are necessarily tied to the sequential and categorial organizations of social interaction.

***Section III: Affiliative Disagreements***

The previous two sections were analyses of what were considered dispreferred forms of disagreement. Uncontested and contested disagreements generally included prefacing, delays, silences, and other linguistic features that disrupt the contiguity of the talk. Affiliative disagreements, by contrast, are a preferred form a disagreement and are patterned much like agreement sequences (Pomerantz, 1984). Affiliative disagreements in this study were often immediate, direct, and clustered. These disagreements typically occurred after one speaker expressed self-deprecating or negative comments. Affiliative disagreements only occurred in WOM group, which may be indicative of the groups' orientation to the institutional goal of providing a space for social solidarity. One-third of the disagreements in this group were affiliative. The affiliative forms of disagreements in this study appeared to have two distinct functions: (1) to move on quickly from potentially embarrassing moments and (2) to perform acts of solidarity. Both forms managed threats to face, though in different ways.

The first example is an affiliative disagreement following a possible attempt to preempt disagreement or critical feedback. Just prior to this exchange, the group members were brainstorming ideas for an upcoming STEM outreach event that they were designing. Etienne proposed the idea of creating a STEM activity related to physical and mental health. Several members of the group were discussing how to make learning about mental health interactive and engaging.

*Excerpt #7 23:2:18:WOM:00:49:14*

ETI: you could do something where they break up into
groups↑ and you have (.) put them in different
scenarios↓ (.) so we would need like some good
volunteers↑ but it could be kinda cool um (.) to
(.) um (.) I dunno like put them in like a really
(.)calming environment and then (.) have the other
one or like another group be in like a more
aggressive (.) environment=

GRM: =mm hm=

ETI: =and another one where they're (.) they have to
talk really loud to their partner or something and
then talk about how they like feel and **>I dunno**
**maybe this is all stupid<**

**RIL: that's [cute]**

**JEN: [n::o]**

GRP: [(group laughter))]

ETI: [(but like)] the comparison is what I think
is interesting and I feel like they're getting (.)
a little bit more exposure to: (.) u:m like mental
health↑

GRP: mm hm

ETI: and that'll sort of connect and really show it
visually instead of just being told it↑

FRA: yeah

**JEN: and even music if you wanted because I had a**
**student((continues with story))**

The activity preceding the disagreement was Etienne sharing an idea (Lines 1-14). The talk was marked by hedges (e.g., I dunno, Lines 5 and 14) and delays, which could be heard as hesitance about the idea that was being offered. The hesitance was actualized with a self-deprecating assessment: "maybe this is all stupid" (Line 14-15). This assessment further downgraded the epistemic status of the idea and subsequently shielded the speaker from harsh critique. The sequential position of the self-degrading comment generated a potential dilemma for other participants. If they agreed with Etienne's comments, the potential for face-threats would be high for everyone involved. For Etienne, an agreement would legitimize the hesitancy and produce an insult. The risks for other speakers were the potential to disrupt solidarity and be marked as anti-social. Alternatively, disagreeing could offer a prosocial, affiliative interactional strategy to reduce the threats to face and maintain solidarity for all parties involved.

A category-occasioned transformation, from "stupid" (Line 14) to "cute" (Line 17), was generated and produced the disagreement in this exchange. Here again, the categories-in-use were unlinked. As was the case in Excerpt #3, the unmitigated, direct disagreement in this example may have made it unnecessary for participants to link the categories across turns. However, the types of categories transformed in this disagreement are worth noting. According to Merriam-Webster's (2020) definition, the adjective "stupid" is tied to intellectual capacity, whereas the adjective "cute" can be "clever or shrewd often in an underhanded manner," "attractive or pretty especially in a childish, youthful, or delicate way," or "obviously straining for effect." The dictionary definition provides little insight into why these two different types of adjectives can be offered without a request for clarification. Pragmatically, offering a positive assessment, whether matched or not, in response to a negative self-assessment allowed speakers in this disagreement to quickly move beyond a potentially embarrassing moment. In other words, Riley's disagreement (Line 14) provided the means for Etienne to save face. Therefore, the sequential, rather than the categorial, aspects of the talk made the disagreement affiliative in nature.

The second example is from and exchange wherein a disagreement was used to perform an act of solidarity. This exchange occurred during a rapport-building activity. During this activity, group members shared high and low points from the prior week. Yasmeen shared that in her mid-term course evaluations for a sociology course, two students complained that she talked about race too much. During the discussion about student complaints, Yasmeen stated: "I'm a Black woman. I can't be anything else." Group members then responded with a cluster or affiliative disagreements. Etienne offered a disagreement that produced a reframing of the problem.

*Excerpt #8: 17:10:17:WOM:12:39*

YAS: so there are definitely students who are
enjoying the class it's just like (.) anytime I
think about I'm doing prep for my class today
(.) and >every time I think about prepping< I
just get so much anxiety because **I'm like**
**(.)I'm failing my students (.) essentially so(.)**
**it's rough ((quiet laughter))**

(0.5)

**ETI: it doesn't sound like you're failing them at all**

YAS: [no (.) yeah]

**ETI: [it sounds like] you're (.) like this could be a**
**great teaching opportunity for them too like**
**>especially since they're< young and they're**

GRM: [mm hm]

**ETI: [like] trying to make sense of the world=**

YAS: =right

**ETI: and (.) >I don't know< like exactly the context↑**
**but if you're able to turn it around and be like**
**if I was a white man teaching about white male**
**sociology↑ that comment never would have come**
**up↓**

YAS: [yeah]

GRP: [mm hm]

**ETI: [because] we think of that as the norm**

YAS: uh huh

**ETI: and like I feel like as a woman I'm sure you**
**feel like it more as a Black woman (.) that like**
**Black womanness (.) is like another thing=**

YAS: =yeah=

**ETI: =that like (.) then you have to bring that in as**
**like a topic**

YAS: mm hmm

**ETI: whereas like what if we taught a sociology class**
**(.) from like the (.) point of view as a Black**
**woman and then like (.) the male part and white**
**part was like(.)something el- else to be**
**brought in after that**

YAS: yeah

ETI: yeah

**YAS: yeah we're actually talking (.) since its race**
**we're talking about the construction of**
**whiteness** ((continues describing future lesson))

The action preceding this affiliative disagreement was a negative self-assessment from Yasmeen (Lines 5-7). Following this assessment, other participants could have either agreed or disagreed. Given the potential threats to face and solidarity involved in agreeing with a negative self-assessment, disagreement provided an interactional strategy for minimizing these threats and performing social solidarity. Unlike the affiliative disagreement in Excerpt #7, Etienne also offered a justification for the disagreement (Lines 15-54). This justification involved the construction of a particular sense of the social world and alternative explanations for the source of the problem students had with Yasmeen's discussion of race. In Lines 15-21, for instance, failing was reframed as a teaching opportunity for "young" students who were "still making sense of the world." This provided a category-based excuse for why students would complain that Yasmeen was talking about race too much. Additionally, the contrast between 'white male sociology' and 'Black woman sociology' provided an explanation for why Yasmeen, a Black woman, was not at fault for the "norms" that students (and everyone, Line 35) were operating under. Notably, the categories in this disagreement were tied to ones previously introduced by Yasmeen and other speakers (e.g., "Black woman", "white male"). Given that assessments are also claims to the sufficient grounds to knowledge about what is being evaluated, Etienne's disagreement warranted justification. Categories, in this case, provided Etienne with discursive resources to both construct a justification and produce a version of the social world that made the negative student remarks make sense.

***Summary of the Analysis of Affiliative Disagreements.*** The affiliative disagreements in this study were distinct from the 'dispreferred' forms discussed in Sections I and II. In Excerpt #7, the affiliative disagreement served the practical purpose of moving on quickly from a potentially embarrassing moment. The disagreement in Excerpt #8 functioned to reframe the issue at hand. In both cases, disagreements allowed for threats to face and social solidarity to be minimized. Categorially, the disagreements were either unlinked (Excerpt #7) or linked (Excerpt #8), which may have been tied to the practical purpose of the disagreement. Strong, direct affiliative disagreements (e.g., Excerpt #7) may not require categorial linking, especially if the purpose is to simply move on as fast as possible. Whereas, categorial linking in less direct affiliative agreements (e.g., Excerpt #8) may be required to maintain cohesion in the disagreement sequence.

***Summary of Findings***

This section provides a summary of the key findings that address the second and third research questions of this dissertation.

**Research Question 2**. *How are disagreements are produced and managed in teaching development meetings for STEM graduate students and future faculty?*

The disagreements in this study were produced in three main forms: *uncontested, contested*, and *affiliative*. The most common form was *uncontested disagreements,* comprising 63.7% of the total disagreements. These disagreements were either weak (indirect, mitigated) or strong (direct, aggravated, Excerpt 3) and served various purposes. Uncontested disagreements were marked by the use of distancing practices, shifts from singular to inclusive pronouns, and other politeness practices (e.g., prefacing). Thus, it was evident that participants were oriented to politeness and worked to manage threats to face in courses of disagreement. Contested disagreements, by contrast, included fewer mitigation markers and often increased threats to face over the course of turns between disagreeing parties. These disagreements did not end until another speaker initiated a disaligning action and were sometimes left unresolved. Contested disagreements made up 29.1% of the total disagreements, though the majority of them (70%)

occurred in the BME group. Thus, a strong group orientation to disagreement and shared rights to turn-taking is likely required for the production of contested disagreements. Similarly, the WOM group was the only group with affiliative disagreements. The production of this form of disagreement was likely tied to participants' orientations to the institutional goal of fostering social solidarity among group members. Given that sharing concerns or problems (i.e., through rapport-building activities) was a structured practice within this group, there were likely more opportunities for affiliative disagreements to arise.

Four general patterns emerged across the data. First, it was evident that disagreements did not always come when they were conditionally relevant. The sequential location of disagreements was largely dependent upon participants' orientations to their rights to turn-taking. In the STEMU group with instructor-controlled turns and chains of IRE, disagreements were often delayed, whereas disagreements the other two groups could occur immediately. As such, disagreements in the STEMU group were likely more disruptive than those in the BME and WOM groups. Another pattern was that storytelling was a pervasive practice that participants used in courses of disagreement. Stories were used by participants in this study to both legitimize and move on from disagreements. Thus, stories were key discursive resources for the intricate work of doing disagreement. Third, group leaders and student members collaboratively managed disagreements. Peers or students would offer support for disagreeing points, introduce alternative perspectives, and initiate disaligning actions that led to moving on from a disagreement. The institutional role of a group leader was conferred privileged rights to ending and responding to disagreements, though whether this occurred was dependent upon participants' orientations to rights to turn-taking and meeting management. Importantly, disagreements served multiple functions related to the institutional goal of promoting instruction change through STEM graduate student and future faculty teaching development. Participants used disagreements to offer critiques, introduce moral dilemmas, raise concerns about the feasibility of implementing evidence-based practice, and to offer support for members experiencing challenges with teaching. Therefore, disagreements were a core feature and critical to the work of facilitating teaching development with STEM graduate students and future faculty.

**Research Question 3**. *How are categories used in the production and management of disagreements?*

Two main categorial practices were evident in the production and management of disagreements. First, participants made categorial links to maintain the cohesion, intelligibility, and progressivity of disagreement sequences. Categorial linking describes how social actors used a category or categorization from prior talk to construct a disagreement as a way to mark the specific point with which a speaker disagreed with. This practice made the disagreements recognizable as such and offered a practical solution to the problem of discontiguity inherent to disagreement adjacency pairs. Categorial linking also made disagreements efficient and end a quickly as possible. The second categorial practice was that disagreements performed *recategorizations* or *resistances to prior categorizations*. Disagreements typically included explanations or justification that simultaneously produced alternative membership categorizations to those from the prior talk. These alternative categorizations often included shifts or reorganization of membership categorization devices in terms of category-bound activities, category-tied predicate, and other aspects of the categorial organization. This reorganization of MCDs makes visible how social actors negotiate, moment-by-moment, competing versions of the social world, and how they use categories to do so. The analysis presented above demonstrates the variation in how social actors track categories, turn-by-turn, in courses of disagreement. The sequential and categorical organizations of social interaction are, therefore, fundamentally linked in courses of social actions. Thus, combining CA and MCA for this study was critical for providing a more detailed account of how sequence and category work together in the performance of disagreements.

**Chapter Summary**

In this chapter, I shared the findings of an analysis of the sequential and categorial organizations of social interactions in STEM graduate student teaching development meetings. Specifically, I used applied CA and MCA to analyze three forms of disagreements that occurred across the groups included in this study: uncontested, contest, and affiliative. I found that the way disagreements unfolded was largely dependent upon group characteristics discussed in Chapter 5. Additionally, this analysis demonstrated that disagreements involve a turn-by-turn negotiation of membership categorizations and competing versions of the social worlds. The findings in this chapter present the general patterns across forms of disagreement and provide a contrast to the deviant cases analyzed in the next chapter.

# CHAPTER 7

# AN ANALYSIS OF DEVIANT CASES OF DISAGREEMENTS IN STEM GRADUATE STUDENT TEACHING DEVELOPMENT MEETINGS

The previous chapter described the general patterns and variations of the categorial and sequential organizations of disagreements in STEM graduate student teaching development meetings. In this chapter, I present the analysis of three deviant cases that were identified from the collection of disagreements in the dataset. *Deviant cases*, also called negative cases, are instances when the phenomena under study vary from the general patterns identified in the broader set of data (Wicks, 2012). The use of deviant case analysis is tied to notions of *nomothetic* and *idiographic* approaches to inquiry. These two terms were originally used by Munsterberg in 1898 and later by American psychologist, Gordon Allport (1937), to make distinctions between research approaches that attempt to produce knowledge about generalizable laws of behavior (*nomothetic*) compared to inquiries that seek to produce particular, non-generalizable knowledge about individuals or single cases (*idiographic*) (Hulburt & Knapp, 2006; Ross, 1963). Ross (1963) argued that deviant case analysis offered a "heterographic technique" that leverages the strengths of attending to both the general patterns of findings and to the distinctiveness of individual cases to enhance analytical claims (p. 337). Ross also suggested that deviant case analyses were useful for testing prevailing theories and identifying potential topics for future study. Thus, deviant case analysis is an important methodological practice for generating robust analytical claims and pointing to future areas of inquiry.

Rapley and Hansen (2006) argued that the treatment of deviant cases is a key difference between quantitative (often *nomothetic*) and qualitative (often *idiographic*) research, particularly EMCA and discursive psychological traditions (see also Maynard & Clayman, 2003; Seedhouse, 2004). Whereas outliers or non-normative data points in quantitative studies are typically treated as ‘error’ or insignificant, EMCA researchers actively search for deviant cases for in-depth analyses to strengthen claims about the general patterns identified across social actions or practices. This methodological procedure has roots in Garfinkel (1967) and his student colleague’s famous *breaching experiments*. The purpose of these experiments was to intentionally disrupt the norms of social interaction to demonstrate how social actors oriented to and acted upon presumably shared social realities and norms. The ethics of these experiments have been questioned, thus EMCA researchers actively seek out *naturally-occurring* deviations from the norm because they both violate and demonstrate normative orientations within interactions (Peräkylä, 2011; Rapley & Hansen, 2006). As with breaching experiments, deviance is defined by how participants treat specific courses of action and mark them as unusual (e.g., with shock or silence) (Peräkylä, 2011). Deviant cases can also be identified by comparing specific instances to the general patterns identified within a dataset (Sidnell, 2013). Two of the deviant cases in this study are instances when the sequential or categorial organizations of disagreements differed from the general patterns described in Chapter 6 and one case was deviant in comparative terms. Altogether, the analysis of these deviant cases demonstrate violations and normative orientations to disagreements within STEM graduate student teaching development meetings in this study.

**Chapter Overview**

This chapter presents the analysis of three types of deviant cases: (1) the absence of agreement or disagreement, (2) an extended delay and response, and (3) an explicit statement of disagreement. Each type of deviance is tied to the preference for agreement, attempts to resolve misunderstandings, and the management of face. The two categorial practices described in the previous chapter, *categorial linking* and *resisting and reorganizing prior categorizations*, also played important roles in marking deviations from the norms in disagreements. In the sections below, I provide an analytical discussion of each deviant case. I conclude with a summary of the key findings from this analysis.

**Analysis and Discussion of Deviant Cases**

One of the goals of a deviant case analysis is to explain *why* and *how* an observation fell outside of what is normatively expected. Within EMCA research, what is normatively expected is based on the inductive analysis of a collection of phenomena and when participants' treat courses of action as unusual (Maynard & Clayman, 2003; Sidnell, 2013). Sidnell (2013) argued that naturally-occurring deviant cases offer strong evidence because they clearly demonstrate participants' orientations to normative structures, including obligations to act, within social interaction. The deviant cases in this study were identified and compared to the general patterns described in Chapter 6. Below, each case is discussed in terms of the sequential and categorial organizations, preference organizations, and general patterns of disagreement. The question that guided this analysis was: *how and why did this individual case deviate – sequentially and categorially – from the general patterns of disagreement in STEM graduate student teaching development meetings?*

***Deviant Case I: Absence of Agreement or Disagreement as Doing Disagreement***

The first deviant case is an instance from the WOM group when the absence of agreement or agreement was treated as doing disagreement. Sidnell (2013) suggested that deviance may be evident by when one speaker does not answer a question (i.e., expected norm), but demonstrates that they should have. Sidnell noted that a response to a non-answer may include apologies or providing reasons for not answering (e.g., "I don't know"). While some of these aspects are interactional features of disagreements, they can be intensified in deviant cases. Prior to the exchange below, a guest speaker, Maren, was sharing tips with the group about how to balance teaching and outreach activities in scientific careers. Maren then asked group members about their experience with outreach.  Purple and green text are used to highlight differences in categorization practices for separate membership categorization devices.

*Excerpt #9: 26:1:18:WOM:36:07*

```
1  MAR:     Jenny had mentioned that some of you are
2           frustrated with your outreach↑ endeavors↑↑ (1.0)
3           a::nd if if you just (.) wanna share real fast
4           where that is↑(.) um:: instead of just me
5           thinking(.) I don't know but >I've probably
6           heard it before< but I can kinda try to answer a
7           few things↑ really quickly
8
9           (1.0)
10 MAR:     are you frustrated with your outreach or
11          engagement when you try to do it ((inaudible))=
```

In Lines 1-7, Maren raised a question that did not initially receive an answer (Line 9). In the initial ask, Maren reported that Jenny, one of the peer leaders, had shared with her that group members were “frustrated” with outreach. This talk both categorized outreach as frustrating and negatively assessed group members’ feelings about the activity. Generally, a second assessment – either agreement or disagreement – is relevant after an initial assessment (Pomerantz, 1984). In this case, speakers could have agreed or disagreed that outreach was frustrating. However, disagreeing would have increased face-threats to Jenny, who presumably shared this information, and Maren, a guest, for being potentially being wrong. Maren oriented to the absence of a response to her initial question as a potential disagreement by reformulating the question (Lines, 11-12). A response to this second question still involved face threats to Jenny and Maren for sharing potentially incorrect information. Michal, a student member, then responded and did so on behalf of the entire group.

*Excerpt #9 cont.*

MIC: =I think one cohesive thing that all of us had
said in the past ((clears throat)) I think this
as well >I don’t wanna speak for you guys**< but**
**(.) a lot of us have said that it’s an issue**
**like you mentioned balancing your research goals**
**with your outreach goals**↑ (.) my advisor is
fantastic about that↑ (.) but I know I’ve heard
from a lot of people in the room that that’s
difficult↑ and I don’t think that’s a unique
experience at all=
MAR: =no it’s not (.) it wasn’t when I went through
and it isn’t now ((laughter))

Two aspects of this response are important. First, Michal’s response did not answer the question about whether outreach was frustrating. The response was not categorially linked to Maren’s prior talk and the question was left unaddressed. Second, Michal referred to earlier points in the conversation to produce an agreement (Lines 15-18). This shifted the conversation from being about whether outreach was frustrating to being about difficulties with balancing outreach and teaching goals. This shift, along with the absence of agreement or disagreement in Michal’s response, implied disagreement, and is an example of preference for agreement (Sacks, 1987). This interactional strategy allowed face-threats, for Maren and Jenny, in particular, to be minimized in the midst of potential disagreement. Michal’s response also demonstrated that a response should have been offered and made evident the social obligation or pressures to respond to questions when they are asked (Sidnell, 2013). Any response, even one that did not answer the initial question, was sufficient enough to keep the conversation going and maintain ambiguity about whether outreach was actually frustrating.

Even though disagreements in this study were often mitigated or delayed, the general pattern was that disagreements were stated and justified. Sequentially, even if speakers produced multiple turn construction units and extended their turns, disagreements were produced without long pauses. Disagreements were also categorially linked, which I argue is an important practice that social actors use to make the specific points of disagreement recognizable across non-continuous units. Thus, this excerpt was deviant because neither disagreement nor agreement was stated, categorial linking did not occur, and it included a long pause. The disagreement likely took this form because of the institutional roles and rights of the peer leader and a guest. A direct disagreement in this instance would have presented significant risks for embarrassment or weakened credibility of institutional authorities. Jenny also did not speak up to clarify or expound upon what she told Maren, so it is possible that Jenny was also oriented to the potential risks of supporting or correcting the guest speaker's assessment that others in the room likely disagreed with. Additionally, since the group was an affinity group for STEM teaching, outreach, and mentoring, reporting frustrations about outreach could have been heard as going against the grain and institutional goals of the group.

### *Deviant Case II: An Extended Delay in Managing Disagreement*

The second deviant case was an instance with a significant delay in working toward 'mutual understanding' or compromise in disagreement. Prior to this disagreement, the instructor, Carrie, facilitated a 30-minute long scientific inquiry activity to demonstrate one evidence-based teaching strategy. Following the demonstration, Carrie invited students to share about their experience with the inquiry activity. Several students responded with disagreements with the teaching approach and shared frustrations about the length of the inquiry-based activity. The excerpt below is the final sequence of the cluster of disagreements offered by students.

*Excerpt #10: 9:10:19.1:STEMU:09:53*

```
CAR:     ((selects next speaker by name - Brad))
BRA:     I think I think this is a naïve question, but
         has anybody studied like an optimal time point
         for these sorts of >cuz this is like< (.) this
         is straight out of the lecture [right]
CAR:                                        [yeah]
BRA:     from the videos so (.) like maybe five minutes
         is too much but or not enough but 10 minutes is
         way too much
CAR:     [kind of]
BRA:     [seven minutes] is [ideal (    )]
CAR:                        [I have like] a a three page
         like this is what you should do uh thing and so
         it does say the whole page takes about 35
         minutes or something like that (.)but (.) I
         don't know as far as research goes with
         different activities Karen I don't know if you
         (.)this is Karen by the way I didn't have her
         introduce herself
```

The disagreement began with a prefaced negative interrogative from Brad about the "optimal time" for inquiry activities (Lines 3-13). Negative interrogatives are questions that imply criticisms or negative evaluations of other speakers' conduct (Heritage, 2002). Based on a study of news interviews, Heritage (2002) outlined some key features of negative interrogatives are that relevant to this disagreement:

- The object of discussion is common knowledge between two speakers and, thus, the question put the facts in plain view
- Negative interrogatives include propositions that can be heard as critical or negative evaluations of a speakers' conduct

- Negative interrogatives invite speakers to endorse or agree with the negative evaluation of their conduct
- Negative interrogatives are often argumentative or challenging and, therefore, invite rebuttals

Though interrogatives are generally social actions that perform requests for information, Heritage (2002) found that the actions achieved by these questions depended on the sequential and interactional environment in which they occurred. Given that Brad's questioning was preceded a series of disagreements, it could be heard as an agreement with prior disagreements. The example offered by Brad noting that five minutes may be short, but 10 minutes may be "way too much" (Line 12), can be heard as an indirect disagreement with the 30-minute activity that Carrie had just facilitated. A request for research to legitimize the practice (Lines 3-5) also generated a challenge to the instructor, which was oriented to as such by the defensive response produced by Carrie (Lines 14-21). Interestingly, Carrie offered a weak disagreement ("kind of", Line 14) with the negative evaluation implied by Brad's question. She then defended the practice with a paper resource (Line 20-21) and deferred to a guest with expertise about research for additional backing (Lines 21-25).

*Excerpt #10 cont.*

KAR: [Hi::]

CAR: [Karen] would you like to introduce yourself
really quick

KAR: Su::re (.) hi:: (.) I'm not like spying

GRP: ((group laughter))

**KAR: I'm spying on Carrie because I also have to**
**facilitate this activity for the first time**

**tonight so I'm like (.) how are you doing it**

GRP: ((group laughter))

KAR: so this is a good a best practice example if you
want to teach something you teach watch somebody
else

GRP: ((group laughter))

KAR: uh but I am the director for the Center for
Evidence-Based Teaching and Learning (.) um
which was a center for teaching and learning
here at STEMU Rema is one of the senior
associate directors that you met (.) last
week (.) she and I (.) co teach the class that
we're (.) teaching tonight and doing this (.)
so (.) nice job (.) **as for data on the amount of**
**time** (.) um to allow the productive um (.)
struggle to go on (.)there is and I was
actually just writing this down I'm going to go
back and look this up Isabelle Morte is a
psychologist here at STEMU who has actually
studied this concept and particular the
productive struggle and so (.) I know she has
data that actually demonstrates that this
frustrating experience that you just went
through is really good for learning like you you
learn and retain information longer and more
effectively than if you're just given the answer
um (.) and so I know she has data on that I
would I would not be (.) maybe lab studies in
psychology so .hhh

CAR: yeah

**KAR: the application to classroom environments I'm**
**always a little hesitant to say (.) you know**

CAR: mm hm

**KAR: take it is translatable um so I don't know if**
**it's been studied in the classroom=**

**CAR: =if you find the paper on would you mind sharing**
**[it]**

**KAR: [yeah] I think I'm gonna throw this slide in my**
**(.) deck before tonight ((laughter))**

CAR: awesome, perfect ((laughter))

**((move on to a small group discussion activity))**

The invitation of an expert opinion two included important aspects of this disagreement. First, Karen's response maintained uncertainty about the optimal time of inquiry activities and shifted the focus to the benefits of productive struggle (Line 61-69), which several students complained about just before Brad's talk. It also cast doubt on the applicability of laboratory studies in psychology to classroom practice (Lines 73-79) and subsequently downgraded the epistemic status of some types of research for legitimizing classroom practice. Carrie then requested information for later and moved on to a new activity. In the general pattern of disagreement, particularly for this group, the sequence would have ended at this point. In each instance when an instructor in the STEMU group moved on, disagreement sequences were not expanded or reopened. In this case, the disagreement was reopened by Carrie after four minutes of small group discussion.

*Excerpt #10 cont.*

[00:02:20-00:06:15]

**CAR: so I just want to follow up really quickly on**
**something Karen and I were talking about is (.)**
**um (.) not just necessarily the amount time you**
**should take for it but (.) the cost benefit**
**analysis right** we all have a classroom we have
>I dunno< an hour and 15 minutes or something
(.) so where do you squeeze it in and is it
worth squeezing it in (.) and so maybe in a
discussion section it would be worth it to spend
more time and we're struggling through it um (.)
but (.) you know (.) how much (.) lecture
material do you have to get in (.) versus how
much do you want them to really know it (.) and

```
105         learn it (.) and what are the most important
106         concepts for them to know (.) and so thinking
107         about that when you're when you're thinking
108         about class is important (.) alright (.) so
109         let's do a quick share out
```

In Lines 92-93, Carrie re-opened the disagreement by accounting for utterances that would deviate from what was planned (i.e., share out from small group discussions, see Lines 108-109). This marked the previous disagreement as unfinished and justified a second rebuttal. Carrie categorically linked the ‘optimal time’ membership categorization device (MCD) from Brad’s initial question in the construction of the rebuttal (Lines 94-95). This tied the rebuttal to the specific point of disagreement and maintained the cohesion of disagreement units that included an extended delayed. Carrie’s response shifted the focus of the disagreement from a specific optimal time to an instructors’ decisions about what would be beneficial for learning (Line 99-101). Thus, in Brad’s talk, the ‘optimal time’ MCD included seven minutes of facilitation as a category-bound activity and Carrie’s rebuttal *resisted* the prior categorization and *transformed* the category-bound activity to ‘what is necessary and beneficial for learning as decided by the instructor’.

This deviant case aligned with the categorical patterns disagreements in this study but differed sequentially. The categorial linking was likely required to increase the intelligibility of the disagreement given the significant delay, disruption, and reopening of the sequence. Sequentially, two possible reasons can be inferred for the extended delay in the rebuttal. First, the cluster of disagreements (including Brad’s talk) made evident group members’ shared skepticism. The skepticism was seemingly unexpected and the instructional authorities were like not prepared to provide an adequate rebuttal (e.g., based on empirical research). The second possible reason for the extended delay was that the first rebuttal from Karen ended with uncertainty and, thus, marked the business of the interaction as unfinished. Though Carrie asked

Karen to share research later, it still left the disagreement, with implied criticisms, unresolved. When Carried moved on to the next activity, it allowed Carrie and Karen additional time to generate a more satisfactory rebuttal. Carrie then offered the second rebuttal, student speakers were not invited to respond, and they moved on to a new activity. This functionally closed the disagreement and marked the second rebuttal as sufficient for closing the business of sequence. Overall, this case was sequentially deviant due to the unusual and unexpected interactional circumstances and categorically normative.

***Deviant case III: Explicitly Stating "I Disagree" While Doing Disagreement***

The final deviant case is from the BME group. This was the only instance in the dataset when a speaker explicitly stated "I disagree" during a disagreement. The rarity of an explicit statement of disagreement supports previous literature that indicates that disagreements are often done indirectly (Sacks, 1987; Pomerantz, 1984; Rees-Miller, 2000). The BME group demonstrated the strongest orientation to disagreement and often did so directly. Thus, it was not surprising that the one instance that explicitly used the words "I disagree" occurred in this group. Prior to this disagreement, group members were discussing ethical dilemmas related to the treatment of cadavers in anatomy and physiology labs. Their conversation was focused on whether using real names or nicknames and providing details about the past lives of cadaver donors would support pre-health and professional (e.g., medical) students to humanize the cadavers during lab sessions. After several minutes of back-and-forth debate about whether using nicknames or real names was more humanizing, the discussion leader, Mary from the Downtown group invited thoughts from the Middletown group members (Lines 1-2).

*Excerpt #11: 3:10:19: BME: 48:03*

MAR: uh Middletown (.) other thoughts about (.)
naming

STE: **I (.) I mean (.) so I would disagree that using names or nicknames humanizes donors** (.) um I think like you were saying really (.) kind of masks (.) the whole (.) fact that they had a life and they had an existence(.) and it it really takes away from that personal aspect (.) um (.) like listening to you **guys talk (.) don't you think it's a disservice to medical students in particular if we're not providing some of those details** (.) like there's only so much preparedness they can have when their gonna be clinicians↓ (.) they're gonna be faced with experiences where they know the names of patients that have passed (.) or that have certain ailments that are beyond their control **(.) and so don't you think (.) part of that starts in the gross lab↓ with learning how to process that this is an individual that had a life and had an existence (.) and to be faced with a reminder of (.)** ya know mortality in life and that life is not just this endless (.) thing

MAR: **I I would agree I just I guess my whole thing is if (.) if they're told that your not going to be provided the name (.) you you aren't gonna have access to that information (.) you↑ have no way humanizing any of it↓** (.) ya know you're just told hey this is ya know (.) I I hate referring to cadavers by their number because that to me I find that to be disrespectful >because then they're just some< ya know they're they're a model their a tool it's like oh ya know table number 4 2 6 (.) good for you

RYA: you're serial number

MAR: yeah (.) it's a serial code ((continues sharing opinion))

In this disagreement, Steven resisted the prior membership categorizations of the 'humanized donor.' Previous speakers had argued that assigning a nickname (i.e., category-bound activity), was one practice for humanizing cadavers. This, they argued, would encourage students to treat cadavers more ethically and with more care. Steven's disagreement countered the idea that assigning nicknames could do so (Lines 4-5, with self-repair on ‘names’). Steven continued the disagreement with a justification that included negative interrogatives (“don’t you,” Line 10-13, 19-23) that produced a critique of masking the realities that future doctors would face. These interrogatives can be heard as a disagreeing stance, rather than a request for information, and warranted a rebuttal (Heritage, 2002). Mary responded defensively and offered an excuse, the absence of information, as a legitimate reason for using nicknames to humanize cadavers (Line 26-36). Similar to the general pattern of contested disagreements, this disagreement was continued when the increasing threats to face warranted a response. The turns were also categorically linked through the negotiation of categorial aspects of the ‘humanized donor’ MCD. Unlike the two other deviant cases, this instance was categorically and sequentially normative. However, it was still deviant because it was the only instance in which a speaker used the words “I disagree” to unambiguously produce a disagreement. This deviant case provides evidence for the fact that speakers may *rarely* perform disagreements directly or unambiguously in STEM graduate student teaching development meetings.

***Summary of the Analysis of Deviant Cases***

To summarize, deviations from the general patterns of disagreement described in Chapter 6 occurred in three specific interactional circumstances. In Excerpts #9 and #10, a guest was present when the deviant case occurred. In the WOM group (Excerpt #9), the guest shared potentially incorrect information as reported speech from the peer leader. A direct disagreement, in this case, presented significant threats to credibility and embarrassment to the institutional leader and guest. Thus, an initial non-response and delayed response both resisted a presumably questionable prior categorization and moved the conversation forward. This made the case sequentially and categorically deviant. The guest in the STEMU group (Excerpt #10) allowed for a formerly closed disagreement to be reopened. This likely occurred because the instructional authorities were unprepared for the cluster of disagreements raised following a demonstration of inquiry-based instruction. Moving on from ‘unfinished business’ allowed the instructor and guest to work together privately to produce a categorically linked, extremely delayed additional rebuttal to the cluster of disagreements. This example was only sequentially deviant and provides further evidence that speakers work to make non-contiguous units cohesive through categorial linking. These two cases demonstrate that invited guests may change courses of action within STEM graduate student teaching development meetings. The third and final deviant case (Excerpt #11) was both sequentially and categorically normative, but was the only instance in which a speaker unambiguously and explicitly stated “I disagree” within a disagreement. This case provides evidence that disagreements in STEM graduate student teaching development meetings in this study were more likely to occur indirectly and that speakers would use alternative, more subtle discursive practices (e.g., interrogatives, contrasts) to make their disagreements recognizable as such.

**Chapter Summary**

In this chapter, I shared the findings of an analysis three of deviant cases identified in the collection of disagreements in STEM graduate student teaching development meetings. The findings of this analysis provided additional evidence for the general patterns described in Chapters 5 and 6 and explained the interactional circumstance that likely contributed to deviations from the normative practices for disagreements. This chapter concludes the presentation of findings. In the next chapter, I provide a comprehensive discussion of the findings, consider implications for science education research, method, and practice, and describe future directions for research.

# CHAPTER 8

## CONCLUDING DISCUSSION, IMPLICATIONS, AND FUTURE RESEARCH

The overarching purpose of this dissertation was to study STEM graduate student teaching development using applied conversation analysis (CA) and membership categorization analysis (MCA). The research questions addressed in this study were:

1. What are the characteristics of the interactional contexts that participants co-constructed and oriented in meetings for multidisciplinary STEM, discipline-specific, and identity-based approaches to teaching development for graduate students and future faculty?
2. How are disagreement sequences produced and managed in teaching development meetings for STEM graduate students and future faculty?
3. How are categories used in the production and management of disagreement sequences in these meetings?
4. How and why did individual cases deviate – sequentially and categorially – from the general patterns of disagreement in STEM graduate student teaching development meetings?

I began this study with questions about what CA and MCA could offer to the study of this topic and, in doing so, how I might contribute to the methodological development of these analytical approaches. This study offered both substantive and methodological contributions. By taking this novel, discursive approach to study of a key reform strategy in STEM higher education, I was able to find that disagreement was a common social activity involved in the practice of promoting instructional change. Disagreements or the nature of disagreements have not been empirically studied in the literature about STEM graduate student and future faculty teaching development. Second, by combining CA and MCA for this study, I identified two candidate systematic practices used by social actors, *categorial linking* and *resistance and recategorization through disagreement*. These practices were made visible as a result of attending to the sequential and categorial organizations of social interaction in tandem. This study demonstrated that indeed CA and MCA have much to offer to efforts to understand and refine the practice of STEM graduate student teaching development. Additionally, this study demonstrated that *categorial systematics* (Stokoe, 2012a, 2012b) is a fruitful area for EMCA research.

**Chapter Overview**

Below I provide a comprehensive discussion of the findings and implications of this study. I begin by situating the study in the literature and the arguments presented in the first four chapters of the dissertation. Then the substantive aspects of the findings from Chapters 5 through 7 are synthesized and discussed. Next, the methodological findings and contributions of this dissertation are discussed. Following this, I describe implications for research, methodology, and practice. The chapter is then concluded with a discussion of future research.

**Concluding Discussion and Implications**

STEM graduate student teaching development has been promoted as a promising practice for education reform in higher education (Connolly et al., 2016; Laursen, 2019). The rationale of this education reform strategy is that if teaching development for evidence-based teaching is embedded within doctoral education, then the next generation of faculty will be more prepared for and likely to use strategies that effectively support learning in STEM disciplines. Additionally, scholars have suggested that this teaching development provides an opportunity to shift the culture surrounding teaching and learning in these fields and, thereby, improve access to success in STEM learning environments (Austin, 2010; Brownell & Tanner, 2012; Connolly et al., 2018). This change strategy promises to improve learning outcomes, support equity, diversity, and inclusivity in STEM disciplines, and contribute to national economic and educational goals (Connolly et al., 2018; Brownell & Tanner, 2012; Kezar & Gehrke, 2015).

As discussed in Chapters 1 and 2, this change strategy has been understudied and underdeveloped. From the review of the literature in Chapter 2, I found at least seven different types of teaching development for STEM graduate student: (1) pre-semester orientations, (2) intensive summer workshops or institutes, (3) courses, (4) departmental meetings for teaching assistants, (5) learning communities, (6) teaching certificates, and (7) future faculty development programs.  These teaching development activities were both short- or long-term and varied widely in focus and content. Recent studies indicated that short term activities, such as pre-semester instructor orientations, were most commonly available and widely used at institutions of higher education (e.g., Schussler, Read, Marbach-Ad, Miller, & Ferzli, 2015; Connolly et al., 2016). Longitudinal studies suggested that activities lasting at least one term (e.g., 16 weeks) yielded the most gains for teaching self-efficacy and impact on future practice (Connolly et al., 2016; Connolly et al., 2018). However, the empirical literature on the STEM teaching development graduate students is sparse (Connolly et al., 2018; Miller, Brickman, & Oliver, 2014), thus meaningful comparisons of teaching development practices have been limited.

This dissertation provided a comparative analysis of three types of STEM graduate student development: a course for a multidisciplinary audience, a co-curricular learning community and affinity group for graduate-level women in STEM, and a department-based seminar for graduate student instructors in biomedical education. Each group met for at least one term, included literature-based discussions of practice, and aligned with what previous literature has suggested are effective approaches to STEM graduate student teaching development (Austin et al., 2019; Connolly et al., 2016, 2018). As noted in Chapter 2, the vast majority of the studies have been evaluations of single programs or relied exclusively on self-reported data (e.g., interviews). Thus, this dissertation contributed to the substantive literature both a comparative analysis and a novel, discursive approach to the study of STEM graduate student teaching development.

In Chapters 3 and 4, I described the theory and method of applied CA and MCA to explain how STEM graduate student teaching development meetings would be studied for this dissertation. Specifically, I argued that language-use and social interaction were central practices for doing teaching development and 'studyable' phenomena to make visible social and cultural practices that bolster and constrain instructional change efforts. I leveraged the analytic and conceptual resources of applied CA and MCA to investigate how participants in teaching development activities worked to achieve the aim of improving postsecondary STEM education and, thereby, explored what new insights this methodological approach could offer to the study of this topic. Very few studies have combined CA and MCA for systematic analyses of discursive practice (e.g., Bateman, 2014 and McHoul & Watson, 1984 for exceptions; see also Stokoe, 2012a). Additionally, I did not find previous studies that combined CA and MCA to study disagreement. Thus, this study addressed both practical and methodological knowledge gaps in the science education and EMCA literature bases. In the sections below, I provide the synthesis and discussion of the findings from Chapters 5 through 7 and consider the broader implications of this study.

***Disagreement in Context: STEM Graduate Student Teaching Development***

Previous EMCA research has shown that disagreements are typically dispreferred social actions due to a bias for social solidarity within interaction (Heritage, 1984; Pomerantz, 1984; Sacks, 1987). This is evidenced by non-contiguous sequences, the use of politeness strategies, and other mitigation markers, for example (Brown & Levinson, 1987; Goodwin, 1983; Rees-Miller, 2000; Sacks, 1987). Some researchers have argued that whether disagreements are preferred or dispreferred is dependent upon interactional contexts and cultures (Netz, 2015; Romera, 2018; Schiffrin, 1984; Siafianu, 2012). In education, disagreement or, more broadly, argumentation is a valued practice to and used to support learning for all ages (e.g., Andriessen & Baker, 2015; Asterhan & Schawrz, 2016). Researchers have suggested many benefits of argumentation for learning, such as improved critical thinking skills, participation in authentic scientific discourse, consideration of alternative points of view, and increased motivation and personal investment in topics under debate (Bathgate, Crowell, Schunn, Cannady, Dorph, 2015; Horn, 2008; Bellon, 2000). This dissertation was not about learning or the learning outcomes of disagreement in STEM graduate student teaching development. However, it is important to highlight that education researchers consider disagreement and debate to be critical parts of the learning process. Thus, the disagreements in this study should be conceived of naturally-occurring opportunities for learning and, therefore, important social actions to investigate within this education reform strategy. The two aspects of the production and management of disagreements were identified in this study: (1) approach to teaching development and (2) forms of disagreement.

**Approach to Teaching Development as a Key Aspect of the Interactional Context.** Chapter 5 presented the analysis of the interactional characteristic and participants' orientations to institutionality for each group. Two of the groups (BME and STEMU) were credit-bearing courses, but the structures of meetings and interactional dynamics were strikingly different. The WOM learning community was demonstrably orientated to social solidarity and less so to disagreement. Thus, a detailed, turn-by-turn analysis of the normative interactional characteristics of each group was necessary. The findings from Chapter 5 suggested that groups were defined by their orientations to *participants' rights* and *disagreement*. I argue that the STEMU, BME, and WOM groups can be described as *instructor-centered, student-centered,* and *solidarity-centered* approaches, respectively, based on their orientations to participants' rights and disagreement. Each approach to teaching development, rather than the specific type of teaching development (e.g., course, learning community), fundamentally shaped both how disagreement sequences unfolded in each group.

In the STEM group, interactions between students and instructors were marked by an asymmetry in rights to turn-taking, sequence management, and topic initiation. While the group included activities that are typically considered student-centered pedagogical strategies (e.g., think-pair-share), instructors played a significant role in the organization of interactions in this group. Instructors in this group controlled turn-taking, led chains of Initiation-Repair-Evaluation sequences (Mehan, 1979), decided topics of discussion, and demonstrated privileged rights to responding to and closing disagreement sequences. Within this *instructor-centered* context, disagreements were disruptive, difficult to initiate, and performed very delicately (e.g., highly mitigated) by students.

By contrast, the BME group demonstrated a *student-centered* approach to teaching development. Participants oriented to shared rights to turn-taking, topic initiation, and management of disagreement sequences. The student-advisor and peer-peer disagreements were very similar in form and did not mark the asymmetry in rights typically conferred by differences in institutional roles. The group also consistently engaged in humor, used nicknames, and relied upon insider understandings (e.g., Excerpt #6, Chapter 6), which was likely indicative of a non-hierarchical culture and relational closeness among group members (Habib, 2008; Rees-Miller, 2000; Romera, 2018). The student-centered approach and amicable relations likely afforded group members the flexibility and capacity to engage robust disagreements without incurring damage to interpersonal relationships.

A *solidarity-centered* approach to teaching development was evident in the WOM group. Similar to the BME group, participants oriented to shared rights to turn-taking, topic initiation, and management of disagreements. However, the group demonstrated a strong orientation to affiliative actions, which aligned with the group's institutional goal of providing a space for solidarity for graduate-level women in STEM disciplines. For example, the peer leaders facilitated structured practices for fostering social solidarity, and group members frequently engaged in affiliative acts (e.g., compliments, praise). Thus, disagreements were highly constrained due to the potential risk of interpersonal conflict that was counter to the groups' solidarity-centered focus.

Overall, the approach to teaching development significantly shaped the interactional environment for disagreement in each group in the study. The *instructor-centered*, *student-centered*, and *solidarity-centered* approaches were co-constructed and oriented to, turn-by-turn, by participants themselves. The student-centered approach in the BME was most conducive to doing disagreement for a few possible reasons. First, the group demonstrated relational closeness as noted above. This allowed for strong disagreement with a seemingly minimal negative impact on relationships. The BME group was also discipline-specific and based within a department. They were able to engage in-depth discussions and disagreements specific to shared disciplinary culture, practice, and values in ways that the STEMU and WOM group likely could not.

Whether teaching development should be discipline-specific or transdisciplinary has been a topic of debate in the literature (Bishop-Williams, Roke, Aspenlieder, & Troop, 2017; Smith &

Kanuka, 2018). Scholars have suggested that transdisciplinary teaching development is important because it can make training widely available (e.g., Kanuka, Heller, & Jugdev, 2008). Alternatively, Smith and Kanuka (2018) argued that teaching-development should be discipline-specific because it takes seriously disciplinary identities, norms, and practices. The comparison between discipline-specific and transdisciplinary teaching development, however, has not been *empirically* studied in the STEM graduate student teaching development literature base discussed in Chapter 2. This study demonstrates the affordances of discipline-specific, institutionally-supported groups for working through how to implement instructional change and how they do so through disagreement. The findings of this study also indicate that affinity-based and instructor-centered groups have considerable barriers to doing disagreement and may need to add structured opportunities for critical conversations to effectively promote learning and encourage instructional change.

**Forms of Disagreement in Teaching Development Meetings.** In Chapters 6 and 7, I presented the analysis of the forms of disagreement identified using applied CA and MCA. Previous taxonomies of disagreement have been based upon mitigation markers (Goodwin, 1983), grounding (Blum-Kulka, Blondheim, & Hacohen, 2002), politeness (Rees-Miller, 2000), and functions (Muntigl & Turnbull, 1998). The typology developed in Chapter 6 was based on whether disagreements ended quickly or kept going, and whether they were dispreferred or preferred. Notably, I identified three forms of disagreements with distinctive patterns and practices. The forms were *uncontested*, *contested*, and *affiliative disagreement*s. How each form of disagreement unfolded was tied to the institutional cultures and contexts co-produced by participants in each group.

Uncontested disagreements were the most common form in this study, comprising 63.7% of the total disagreements. These were a dispreferred form of disagreement, they ranged from weak (indirect, mitigated) to strong (direct, aggravated), and served many purposes (e.g., offered critiques or suggestions for practice). The production of uncontested disagreements included prefaces, pronouns shifts (e.g., "I" to "we"), and other politeness practices that minimized threats to face and social solidarity. This is consistent with previous EMCA literature that suggests that social actors design turns to minimize disagreements and are oriented to politeness within interaction (Brown & Levinson, 1987; Drew, 2013; Rees-Miller, 2000; Sacks, 1987). These findings also provide supporting evidence that participants are likely to end disagreements quickly when possible.

The *contested disagreements* were instances when disagreements were extended and involved back-and-forth disputes. These were also a dispreferred form of disagreement as they included fewer mitigation markers, increased threats to face increased over the course of turns between disagreeing parties, and posed risks to social solidarity. Contested disagreements did not end until another speaker initiated a disaligning action and were sometimes left unresolved. Contested disagreements made up 29.1% (37/127) of the total disagreements. However, 70% (26/37) of the contested disagreement occurred in the BME group. Consistent with previous literature, disagreements can persist in interactional contexts and cultures that treat them as allowable (e.g., Netz, 2014; Romera, 2018; Schiffrin, 1984). In this case, BME group participants' orientations to disagreement and shared rights to turn-taking (among other things discussed above) likely produced the interactional conditions that allowed for ongoing, back-and-forth disputes. In the STEMU and WOM groups, however, contested disagreements were rare, making up only 8.6% (11/127) of the total disagreements. These findings support literature that suggests that whether disagreements are treated as allowable depends on the interactional context within which they occur.

Relatedly, *affiliative disagreements*, a preferred form, was a distinctive type of disagreement found in this study. These disagreements were similar to the production of agreements in that they were immediate, direct, clustered, and maintained or bolstered social solidarity in interaction (Pomerantz, 1984; Sacks, 1987). Affiliative disagreements only occurred in the WOM group and made up only 6% of the total disagreements. Though dispreferred forms of disagreement (i.e., uncontested and contested) did occur in the WOM group, they were demonstrably treated as disruptive to the affiliative culture co-produced by participants, as well as the institutional goal provide a space for solidarity among graduate-level women in STEM disciplines. Additionally, since affiliative actions (e.g., compliments) and sharing concerns (i.e., through rapport-building activities) were normative practices within this group, there were more opportunities for affiliative disagreements to arise within WOM's interactional environmental compared to the other two groups. This provides additional evidence that the institutional cultures and goals of each group were consequential in shaping the forms of disagreement that occurred.

The four main patterns across all groups were related to the (1) location of disagreement sequences, (2) storytelling sequences, (3) collaborative management of disagreements, and (4) varied functions of disagreements. First, disagreements typically occurred during portions of the meeting dedicated to the discussion of evidence-based teaching. While disagreements were in response to a range of activities and actions (e.g., sharing opinions, self-deprecation, see also Chapter 5), they were most likely to occur following discussions of evidence-based teaching or suggestions for practices. This pattern indicates that resistance, questioning, and negotiation of evidence-based educational practice can be expected during STEM graduate student and future faculty teaching development meetings. Second, storytelling was a very common discursive practice that participants used in courses of disagreement. This is consistent with previous studies that found that stories or narratives were powerful explanations for settling or justifying disagreements (Kjaerbeck, 2008; Myers, 1998). Third, participants in these groups *collaboratively* managed disagreements. Students and peers alike actively worked to reach a ‘mutual understanding’ between competing points of view and settle disagreements. Finally, the disagreements in this study served critical purposes related to the institutional goal of promoting education reform through STEM graduate student and future faculty teaching development. Disagreements were used to offer critiques, raise moral dilemmas, question feasibility of implementing evidence-based practice, and provide collegial support for dealing with the challenges associated with teaching. These disagreements made visible both moral and practical barriers to changing educational practices in STEM disciplines.

The nature of disagreements, as well as their potential benefits and drawbacks, in STEM graduate student teaching development meeting, has not been empirically studied in the literature base discussed in Chapter 2. Scholars have argued that disciplinary cultures and resistance to change are key barriers to STEM education reform (e.g., Brownell & Tanner, 2012; Connolly et al., 2018), yet the current literature base offers little empirical evidence about the nature of these resistances or what they look like in practice aside from the minimal uptake of evidence-based teaching and mentoring practices. Resistance due to limited skills or resources for implementing evidence-based teaching is fundamentally different than resistance from an instructor questions whether all students can learn. Both types of resistance are important and the disagreements in this study made visible the varied ways in which participants question or resist both the moral and practical implications of evidence-based educational practices. Thus, this study contributes important knowledge to the field of science education about how participants actually resist, question, and negotiate changes in educational practices within STEM disciplines, and has important implications for research and practice.

### *The Methodological Challenge: CA and MCA in Tandem*

The methodological contribution of this dissertation is twofold. First, I took a novel methodological approach to the study of STEM graduate student teaching development. Second, I combined applied CA and MCA to study the sequential and categorial organizations of social interaction. As discussed in Chapter 3, the development of the methods for analysis in CA and MCA have occurred in silos (Schegloff, 2007a; Stokoe, 2012a). MCA, in particular, has been underdeveloped and the current literature includes limited guidance for how to actually do categorial analyses (Fitzgerald & Housley, 2015; Hester & Eglin, 1997; Stokoe, 2012a). Analyzing categorial organization is further complicated because membership categorizations are often taken-for-granted, ambiguous, and implied in ways that are not readily visible to analysts (Baker, 2000; Stokoe, 2012a). Nevertheless, combining CA and MCA provided a set of analytical and conceptual resources to examine how “cultural knowledge and logic in use” (Baker, 1997, p. 103) and disagreement were intertwined in this study.

At the same time, Stokoe (2012a, 2012b) and others have called for more studies of *categorial systematics* to better increase knowledge about the systematic way in which social actors use categories to produce social actions and negotiate versions of the social world (see also *Discourse Studies* Special Issue, 2012). This is study was also an effort to add the corpus of studies of categorial systematics and contribute an example analytical approach for these sorts of investigations. Notably, two distinctive categorial practices and, arguably, candidate categorial systematics were uncovered through this study of the sequential and categorial organizations of disagreements: (1) *categorial linking* and (2) *categorial resistance and transformation*. I discuss each practice below.

**Categorial Linking in Disagreement.** *Categorial linking* describes how social actors use categories or categorizations from the prior talk to link specific points with which they disagree. Categorial linked units are to categorial organization what adjacency pairs are to sequential organization. The first part of the linked unit is the point of contention from prior talk and the second part is the initiation of the disagreement sequence. Together, the two parts produce coherence across the production of disagreement sequences and contributed to the overall intelligibility of the talk. All but three instances (2.4%) were categorically linked. Two of the instances that were unlinked occurred in strong disagreements (Chapter 6, Excerpt #3, Chapter 7, Excerpt #9) and the third instance was a strong affiliative disagreement (Chapter 6, Excerpt #7). The strength of disagreements, however, did not explain why these instances were unlinked because the other strong disagreements in the study were linked. I also found deviant cases that were either categorially linked or unlinked (Chapter 7). Furthermore, sequential deviance did not correlate with categorial deviance. It is likely that categorial linking a normative practice, though it may not be necessary for strong, unambiguous social actions. With this study, I argue that categorial linking is a candidate categorial systematic practice that social actors use to remediate the problem of non-contiguity in disagreement sequences and, thereby, increase the recognizability of points of contention.

**Resisting and Transforming Membership Categorizations with Disagreement.** The second candidate categorial systematic proposed with this study is that disagreement performs *categorial resistance* and *transformation*. Category-occasioned transformation (Jayyusi, 1984) is, therefore, a discursive feature of disagreement. In each disagreement sequence in this study, various aspects of MCDs were modified. At the very least, category-tied predicates, category-bound activities, standard relational pairs, and duplicative organizations were points of resistance, critique, and transformation. For comparison, I demonstrated that agreement produced *acceptance* and *expansion* of prior membership categorization (Chapter 6, Excerpt #1). These findings provide evidence that particular social actions *can* and *do* produce a particular categorial (re)organizations across sequences of talk. This finding builds a strong case for combining CA and MCA for future in-depth studies of categorial systematics. Furthermore, this study demonstrates what Baker (2000) called the "micropolitics of everyday and institutional life" (p. 99). Disagreements functioned as microsites of resistance and transformation as participants in STEM graduate student teaching development meetings negotiated membership categorizations related to teaching, learning, and educational equity. Thus, the methodological contributions of this dissertation also have practical significance for understanding how competing versions of educational life collide within efforts to promote instructional change.

The methodological contributions of this study are also tied to the analytical practices of EMCA research approaches. Analysts typically draw upon the findings of past empirical studies to characterize social actions, identify new practices, and strengthen claims (Potter, 2012; Schegloff, 2007). As such, past studies are key resources analysis for warranting analytical claims in EMCA approaches. The findings of this study offer analytical resources for characterizing disagreements in terms of categorial organization and contributes to the empirical literature base in the context of education. In alignment with prior critiques of treating disagreement as fundamentally disruptive to social solidarity (e.g., Netz, 2014; Schiffrin, 1984; Siafianu, 2012), this work also provides examples how three distinctive interactional contexts and cultures of STEM graduate student teaching development that produced environments that were either conducive to or prohibitive of disagreement. As discussed above, each group's institutional culture and approach to teaching development (e.g., student-centered) made significant differences in whether disagreements were encouraged or discouraged. Additionally, one form of disagreement was demonstrably affiliative (albeit a preferred type, Pomerantz, 1984). Thus, this dissertation provided additional empirical support for the critiques of characterizations of disagreement as a purely negative or anti-social action.

### *Implications for Science Education Research, Methodology, and Practice*

In the discussion above, I highlighted the key findings of this study that have important implications for science education research, methodology, and practice. I focus this discussion narrowly on three areas of implications most relevant to this dissertation: (1) implications for studies of STEM higher education reform strategies, (2) methodological implications for studies of categorial systematics, and (3) implications for change leaders and practitioners of STEM graduate student teaching development.

**Implications for Research on STEM Higher Education Reform: A Discursive Approach.** While various approaches to discourse analysis and conversation analysis are widely used science education research in K-12 settings (e.g., Roth, 2013; Kelly, 2014), discourse studies are rare in STEM higher education contexts and postsecondary education in general (see also Patton-Davis, 2014). This may be because scholars of disciplinary-based education research (DBER) in higher education are primarily in fields outside of education (e.g., astronomy, biology, chemistry) and may have limited familiarity with the theories and methods typically used in education research (Borrego & Henderson, 2014). Additionally, researchers have suggested that the educational theories and research are often inaccessible to STEM faculty and institutional leaders who are looking to change practice (Borrego & Henderson, 2014; Henderson et al., 2011). Arguably, studies of STEM education reform strategies and DBER scholarship could be enhanced and strengthened through deeper engagement with fields of education. Importantly, as I argued in Chapter 2, this requires scholars to move beyond siloed efforts toward more cross-disciplinary approaches to study and promote change in STEM higher education.

This dissertation took seriously the current DBER literature base, drew upon research practices commonly used in K-12 settings, and leveraged the methodological resources of applied CA and MCA to study one particular STEM education reform strategy. Educators and education researchers often observe or record and analyze classroom practices to reflect upon and improve teaching and learning outcomes. Studies of STEM graduate student teaching development, however, rarely included recordings or observations of practice (see Chapter 2). This dissertation used recordings of teaching development meetings and, because of this, I was able to identify patterns in the facilitation of teaching development and (sometimes missed) opportunities for learning (i.e., disagreements). The first important implication of this work is that a stronger culture of inquiry about practice is needed to further refine how STEM graduate student teaching development is done in higher education. A culture of inquiry might include peer observations or recordings of meeting facilitation, feedback on practice, and publications about this work. A closer look at current practice could provide key insights into what works well, help identify common barriers and teaching development needs, and potentially explain the what researchers have described as variation in the quality and outcomes of STEM graduate student teaching development efforts (Connolly et al., 2018; DeChenne et al., 2015; Wyse et al., 2014).

Furthermore, this dissertation builds a strong case for drawing upon discursive perspectives, EMCA, and discursive psychology (DP) in particular, for studies of STEM education reform strategies. These approaches treat language-use as a central medium for human action and analysts closely examine how social actors use language to carry out the business of their everyday and institutional lives (Potter & Hepburn, 2008; Stivers & Sidnell, 2013). This dissertation focused narrowly on one specific social action, though other actions, such as learning and teacher beliefs, are relevant to STEM higher education reform efforts. EMCA and DP provide alternatives to mentalistic research approaches that treat learning and teacher belief as psychological states that reside 'in the heads' of individuals and instead respecifies these as public, accountable conduct produced through language-use (e.g., Hendry, Wiggins, & Anderson, 2016; Hester & Francis, 2000; Warren, 2016). The second implication of this dissertation, then, is for the respecification psychological states (e.g., teacher beliefs) and sociological concerns (e.g., social change) in terms of language-use so that we may better understand the myriad of ways social actors work together to achieve STEM higher education reform.

**Implications for Methodology: Moving Forward with Categorial Systematics.** Stokoe (2012a, 2012b) and other EMCA scholars have called for increased studies of categorial systematics. Stokoe (2012a) outlined key concepts and recommendations based on Sacks (1972a, 1972b) to provide guidance for conducting categorial analyses. As discussed in Chapter 4, I began analysis in alignment with Stokoe's (2012a) suggestion, tracked instances when specific categories were used (e.g., gender, disciplinary identities, student, teacher), and sought to explore how social actors used language to produce membership categorizations (e.g., "good scientist" or "bad scientist") while doing STEM graduate student teaching development. With this approach, possible categorial systematics remained ‘elusive’ and invisible to me because social actors seemed to use and produce a single category in varied, messy, and contradictory ways. As Baker (2000) importantly argued, categorization work is most powerful when it is taken-for-granted and, therefore, seemingly invisible. As such, I assumed the invisibility of categorial systematics was not a shortcoming of the methodological approach, per se, but instead it was evidence that powerful categorization work was at play. It also indicated that perhaps an alternative to focusing on a single category or categorization was needed to uncover categorial systematics.

Baker (2000) suggested that because culture is internal to action, it is possible to see how competing versions of culture might collide within social interactions. Similarly, disagreements in this study provided an opportunity to examine naturally-occurring instances when competing views of the social world were made public. This study lent itself well to analyzing how categorizations were negotiated across disagreement sequences and generated insights into two candidate categorial systematic practices. Combining applied CA and MCA also helped to make these practices visible and further demonstrated the sequence-category entanglement within social interaction. Thus, the third implication of this study is an expansion of the analytical approach for identifying categorial systematics. This dissertation presents a strong case for beginning studies of categorial systematics by examining patterns of category-use across single types of action sequences (e.g., acceptances, rejections). Additionally, comparing patterns between with opposing actions (e.g., acceptances versus rejections) can further warrant claims about categorial systematics. A comparison of turn-by-turn categorizations for disagreements and agreements in this study strengthened the evidence for categorial patterns and made them more noticeable. This work also has implications for refining the analytical approach for studying categories and categorizations that are taken-for-granted and unquestioned.

**Implications for Change Leaders: Managing Disagreement and Resistance to Change.** One of the main findings of this study was that disagreement is a common social practice involved in doing STEM graduate student teaching development. As shown in Chapter 5, the disagreements were most frequently in response to discussions of evidence-based teaching and suggestions for practice. This study demonstrated that disagreements and resistance are likely to occur in these meetings, thus change leaders will need to be prepared to respond to critical questioning and skepticism when they unexpectedly occur. Importantly, disagreements helped make visible moral dilemmas related to teaching and learning, questions about the feasibility evidence-based teaching in particular settings (e.g., large class sizes), and potential barriers within disciplinary cultures, for example. Instead of attempting to minimize or reduce disagreements, however, practitioners should consider how to build in opportunities for disagreements and leverage them for learning. Leveraging disagreements in change efforts would require practitioners and students to work together to foster professional learning environments wherein disagreements are treated as valuable contributions to STEM education reform. Additionally, it will be important to consider the various factors, such as socialization, culture, and development that may shape how students and teaching development facilitators orient to and participate in disagreement.

## Future Research

This dissertation study opened up many directions for future study. I plan to pursue three promising areas for future research (1) culture and change in discipline-specific (e.g., chemistry) graduate student teaching development communities (2) practices for solidarity in identity-based affinity groups, and (3) in-depth examination of how practitioners introduce evidence-based teaching.

The BME group is this study provided a rich example of the promise of discipline-specific teaching development efforts. Participants in this group centered disciplinary goals, values, and identities while they engaged in in-depth debates and discussions about concrete practices (e.g., teaching lab practicums) to improve teaching and learning in biomedical and health education. In comparison, the conversations in the STEMU and WOM groups were generally high-level and disconnected from actual practice. The BME group represent one possible model for graduate student and future faculty development that can leverage discipline-specific culture for change. More in-depth studies are needed of discipline-specific education reform strategies in various fields. These studies will be critical for fields that have persistent learning disparities and exclusionary cultures (e.g., physical sciences and technology) that significantly impact students marginalized due to the sexism, racism, ableism, and other systems of oppression enacted within STEM learning environments (Medin & Bang, 2014; Cheryan et al. 2017; Ong et al., 2018; Wilkins-Yel et al., 2019). Thus, future studies of discipline-specific STEM higher education reform can support targeted transformation and promote equitable access to learning and participation in the fields that need it the most.

The second area of research I plan to pursue as a result of this study is identity-based (e.g., race, gender) development for STEM graduate students and future faculty. The WOM group demonstrated a distinctive affiliative orientation, which I hypothesize can also be leveraged to promote instructional reform in STEM higher education contexts. Prior research has shown that graduate-level women and women of color, in particular, have differential access to mentorship and professional development, limited opportunities for peer-to-peer support, and are often discouraged from pursuing faculty and leadership roles in academia (McDaniels & Austin, 2006; Rosser 2017; Wilkins-Yel et al., 2019). As such, affinity groups can offer spaces for solidarity and support, provide one way to address critical gaps and professional learning for graduate-women and women of color, and support persistence in STEM disciplines. Thus, I plan to explore how participants in these groups work to achieve solidarity while simultaneously supporting professional growth toward the goal of reform in STEM higher education.

The third and final area of future research is related to the actions and activities that preceded disagreement in this study. Though disagreements are generally considered unpredictable (Pomerantz, 1984; Sacks, 1987), a pattern emerged in this study that made the points of contention somewhat predictable. Disagreements in this study most often occurred in response to discussions of evidence-based teaching strategies and suggestions for practice. An in-depth analysis of the introduction of evidence-based research is needed to better understand similarities in how these sequences of talk are produced. This analysis could explain what makes disagreement a common next relevant action in these meetings. Furthermore, the preceding action paired with the following disagreements could be useful for workshops with practitioners of STEM graduate student teaching development. Stokoe (2011) developed the Conversation Analytic Role-Play Method (CARM) to support practitioners to strengthen their work-related skills (e.g., therapy) using recordings of real-time interaction. The dataset from this study could be used to create STEM graduate student teaching development CARM modules and support practitioners to both refine how they introduce evidence-based teaching and explore possible ways to respond to concrete examples of disagreements that arise in meetings.

**Chapter Summary**

This chapter synthesized the key findings presented in three analysis chapters: the institutionality and interactional contexts of three types of STEM graduate student and future faculty teaching development (Chapter 5), the sequential and categorial organizations of disagreements (Chapter 6), and the analysis of three deviant cases (Chapter 7). These findings were situated in a broader discussion of the literature on STEM graduate student teaching development. Through this dissertation, I demonstrated the benefit of taking a discursive approach and examined how disagreements made visible practical and moral concerns surrounding STEM higher education reform. Methodologically, by combining applied CA and MCA for this study, I joined the conversation of EMCA scholars working to better analyze sequence-category ties in the organization of talk-in-interaction (Hester & Eglin, 1997; Stokoe, 2012a). My overarching goal for this dissertation was to contribute to the scholarship that seeks to promote more equitable access to success and participation in STEM disciplines. The recent *Levers for Change* report published by the American Association for the Advancement of Science indicated that the professional development of instructors, graduate teaching assistances, and future faculty is a medium-to-highly influential practice to promote instructional change in STEM higher education (Laursen, 2019). As demonstrated through this study, professional development is unavoidably done through discourse. Thus, as Sacks (1979) importantly argued:

> the important problems of social change…would involve laying out such things as the sets of categories, how they're used, what's known about any member, and beginning to play with shifts in the rules for application of a category and with shifts in the properties of any category. (p. 14)

For an educational change, then, a shift in discourse and categories will need to occur so that future faculty and students can co-create environments that promote equity, diversity, and inclusivity so that *all* students can learn and participate in STEM.

APPENDIX A

**Email Introduction Sent to Institutional Leaders by the NextSTEM Network Contact**

July 2, 2019

Dear «First_Name»,

I am writing today to provide a virtual introduction to Francesca (White) Williamson, a doctoral student at Indiana University. Francesca is a member of the NextSTEM network, having attended a network meeting, the occasional virtual meeting, and having co-facilitated a network learning community offering.

Francesca will likely be reaching out to you in the coming days as she is beginning her own dissertation around the topic of STEM teaching development. She is reaching out to individuals running local STEM teaching development programs.  (see details below)

**About the study**

The purpose of this study is to examine how language is used to promote instructional change in teaching development activities designed for STEM graduate students and future faculty.  The data will include audio and/or video recordings of face-to-face teaching development activities (e.g., learning community meetings). Findings from this study will provide direct and specific implications related to preparing STEM graduate students for teaching and provide key insights about teaching development for graduate students as a strategy for undergraduate STEM education reform.

Francesca (White) Williamson, Ph.D. Candidate, Indiana University, Science Education and Inquiry Methodology (frawhite@indiana.edu)

Dissertation Co-Chairs:

Jessica Nina Lester, Ph.D., Inquiry Methodology

Gayle Buck, Ph.D., Science Education

Again, I just wanted to take a moment to introduce Francesca. Based on my understanding of your local programs, I thought you would be a good person for Francesca to talk to. Please watch for an email from Francesca. Where it goes from there is up to you.

Take care,

**Network Contact**

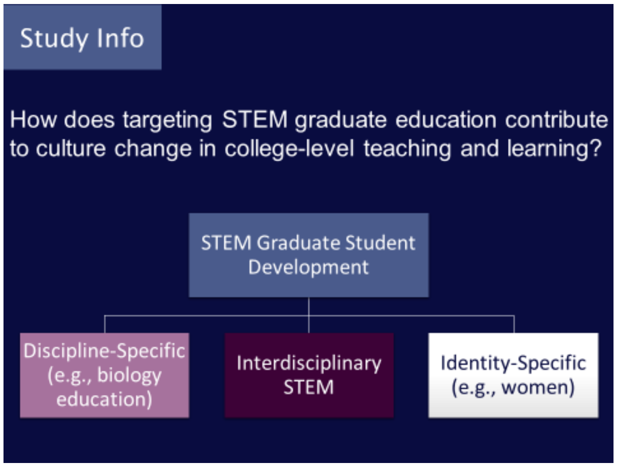
APPENDIX B

**STEM Graduate Student Teaching Development Dissertation Study: Learning Community Facilitator Recruitment Form**

| |
|---|
| Thank you for your interest in participating in my dissertation study. In the coming weeks, I will send you an email to schedule a 60-minute online group meeting in July or August 2019 to discuss the project, aims, and answer questions you may have about the study. Questions? Contact Francesca Williamson at frawhite@indiana.edu.<br>* Required<br>First Name *<br><br>Last Name *<br><br>Role/Title *<br><br>Your answer<br>Email *<br><br>Institution/University *<br><br>How often does your education training/learning community for STEM graduate students meet? *<br>Less than once a month<br>Monthly<br>Every two weeks<br>Weekly or more<br>Other:<br><br>Are you or your designee available to collect video/audio recordings of education training/learning community sessions? *<br>Note: Individuals who collect recordings will be compensated.<br>Yes<br>No<br>Do you or your designee have free access to video/audio recordings equipment through your institution? *<br>Yes<br>No |

APPENDIX C

## Recruitment PowerPoint Slides




APPENDIX D

**Jeffersonian Transcription Symbols**

The transcription symbols represented in the findings based on Jefferson (2004) and more recent developments in EMCA transcription (Hepburn & Bolden, 2017).

| Symbol | Description | Use |
|---|---|---|
| `((laughter))` | Transcriber comments | Double parentheses are used to note transcriber comments (e.g., laughter). |
| `(word)` | Uncertain hearing | Single parenthesis are used to mark uncertain hearings for specific words. |
| `(     )` | Unclear speech | Single parenthesis are used to make talk that is difficult to hear or understand. |
| `[talk]` | Overlapping speech | The left bracket ( [ ) indicates the beginning and the right bracket ( ] ) indicates the end of overlapping speech. For example, overlap between the words “to” and “oh” below:<br>ABI: I was going [to]<br>IYL: [oh] it’s okay |
| `> talk <` | Faster paced speech | Talk enclosed in greater than and less than symbols indicates that the speaker delivered their talk at a faster pace than before or after the symbols. |

| | | |
|---|---|---|
| < talk > | Slower spaced speech | Talk enclosed in less than and greater than symbols indicates that the speaker delivered their talk at a slower pace than before or after the symbols. |
| Underline | Underline | Underlined text is used to indicate hearable emphasis on specific words. |
| : | Stretched sounds | A colon is used to represent stretched delivery of portions of talk (e.g., oka::y) |
| = | Latching | An equal sign is used to represent instances when speaker transition turns without audible silences. |
| ta- | Cut-off sounds | A hyphen is used to mark instances when a word is cut off in talk. |
| ↑ or ↓ | Rise and fall of pitch | Upward and downward arrows are used to indicate the rise and fall of pitch, respectively, in the delivery of talk (e.g., okay↑) |
| (.) or (0.5) | Gaps or pauses | Single parentheses are used to indicate gaps or pauses in the talk. Gaps are silence between turn constructional units (TCUs) and are noted a separate line of transcript. Pauses are silences within TCU and are placed in line with transcribed speech. The |

| | | |
|---|---|---|
| | | symbol (.) is used to represent brief or micropauses. Single parentheses that include a number represent the length of silence in seconds (e.g., 0.5 seconds). |

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Wilkins-Yel, K. G., Hyman, J., & Zounlome, N. O. (2019). Linking intersectional invisibility and hypervisibility to experiences of microaggressions among graduate women of color in STEM. *Journal of Vocational Behavior,* 113, 51-61. https://doi.org/10.1016/j.jvb.2018.10.018

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CURRICULUM VITAE

**Francesca Arielle (White) Williamson**

## EDUCATION

**PhD, Dual major: Curriculum & Instruction with a concentration in Science Education; Inquiry Methodology** **2020**
Indiana University, Bloomington, IN

Dissertation title: Using Applied Conversation Analysis and Membership Categorization Analysis to Study STEM Graduate Student Teaching Development

Committee: Gayle Buck (Co-Chair, Science Education), Jessica Nina Lester (Co-Chair, Inquiry Methodology), Valarie Akerson, Barbara Dennis, Kerrie Wilkins-Yel

**BS, Biological Sciences** **2012**
Washington State University, Pullman, WA

## ACADEMIC APPOINTMENTS

*Postdoctoral Fellow – STEM Education Research*, Center for Urban Ecology and Sustainability, Butler University, Indianapolis, IN 2020-Present

*Research Assistant*, The University Graduate School, Indiana University 2018-2019
Designed and conducted research on STEM graduate student and future faculty development.

*Graduate Assistant,* The University Graduate School, Indiana University 2017-2018
Coordinated and implemented programming for graduate and postdoctoral scholars as part of the Center for the Integration of Research, Teaching, and Learning (CIRTL) network.

*STEM Graduate Assistant*, Groups STEM Initiative, Indiana University 2014-2017
Developed, implemented, and evaluated programmatic efforts that support undergraduates from groups underrepresented in STEM fields. Designed and established the Groups STEM Initiative Peer Mentoring Program in 2015.

## RESEARCH EXPERIENCE

(+ indicates community-engaged scholarship)

**Publications**

Howell, G. L., Wright, C., Williamson, F. A., Overby, K. (in press, 2020). Let's "S.L.A.Y." Together: Building sisterhood, scholarly identity, and solidarity among black women doctoral students.

Williamson, F. A. & Buck, G. A. (in press, 2020). Understanding equity in postsecondary STEM: A transformative self-study. In B. Polnick, B. Irby, & J. Ballenger. (Eds.). *Girls* *and Women of Color in STEM: Navigating the Double Bind in Higher Education*. Charlotte, NC: Information Age Publishing Inc.

Lester, J. N., White, F. A., & Lochmiller, C. R. (2017). Discursive approaches to the study of educational policy. In J. N. Lester, C. R. Lochmiller, and R. E. Gabriel (Eds.) *Discursive Perspectives on Education Policy and Implementation* (pp. 41-64). Palgrave Macmillan.

**Additional Written Works**

Williamson, F. A. (2019). Book review: Elizabeth Couper-Kuhlen and Margret Selting, Interactional Linguistics: Studying Social Language in Interaction (invited review). *Discourse Studies, 21*(4), 485-486. https://doi.org/10.1177%2F1461445619847786b

Williamson, F. A. (2019, January). Pursuing and writing for grants: Tips for graduate students [Blog post]. Retrieved http://narstgradresources.blogspot.com/2019/01/pursuing-and-writing-for-grants-tips.html

Williamson, F. A. (2018, May). Using digital tools for qualitative research Projects [Blog post]. Retrieved from http://narstgradresources.blogspot.com/2018/05/using-digital-tools-for-qualitative.html

White, F. A. & Lester, J. N. (2018). Book Review: Sally Wiggins, Discursive Psychology: Theory, Method and Applications. *Discourse Studies 20*(2), 310–311. https://doi.org/10.1177%2F1461445617747650b

White, F. A. (2015). Using ATLAS.ti Mobile Android Application for Interviews. *American Educational Research Association (AERA) Qualitative Research Special Interest Group Summer 2015 Newsletter*. Retrieved from http://aeraqrsig.org/wpcontent/uploads/2015/09/QRSIGSummer2015v2.pdf

**Conference Presentations**

International and National

Davis, B. L., Wilkins-Yel, K. A., & Williamson, F. A. (accepted, 2020, June). Supporting STEM learning and disciplinary identification among women of color through engagement in a transformative counterspace. Poster selected for presentation at the International Conference of the Learning Sciences (ICLS). Nashville, TN.

Williamson, F. A. (2020, March). Preparing STEM graduate students for change: A discursive approach to the study of instructional reform efforts. Poster selected for the Abell Scholars Symposium (Conference canceled due to the COVID-19 pandemic) NARST Annual International Conference. Portland, OR.

Williamson, F. A., Palmer, D., & Priddie, C. (2019, November). Toward a culturally relevant STEM doctoral education. Roundtable paper selected and presented at the Association for the Study of Higher Education (ASHE) Annual Conference. Portland, OR.

+Wilkins-Yel, K. A. & Williamson, F. A. (2019, October). Teach and transform: Advancing STEM persistence among women of color through a multigenerational mentorship framework. Invited workshop presented at the National CIRTL Forum at Drexel University. Philadelphia, PA.

+Williamson, F. A. & Wilkins-Yel, K. A. (2019, October). I CAN PERSIST STEM Initiative: A culturally-responsive approach to career and professional development for graduate women of color. Poster selected and presented at the National CIRTL Forum at Drexel University. Philadelphia, PA

Williamson, F. A. (2019, March). Developing critical pedagogues through STEM Doctoral Education. Invited presentation for the Equity and Ethics Committee Symposium at the NARST Annual International Conference. Baltimore, MD.

+ Donohue, K., Williamson, F. A., Buck, G. A. (2019, February). Graduate women in STEM teaching fellows: A learning community focused on leadership. Poster selected and presented at the American Association for the Advancement of Science (AAAS) Annual Meeting. Washington, DC.

+ Williamson, F. A. & Donohue, K. (2018, October). The Graduate women in STEM teaching fellows program design. Selected and presented at Biology Teaching Assistant Project (BioTAP) Virtual Conference.

Williamson, F. A. (2018, March). Discursive construction of STEM participation and identities in promotional videos. Poster presented for the Jhumki Basu Scholars Symposium at the NARST Annual International Conference. Atlanta, GA.

Nathan, A., Howell, G., White, F., A., & Harris-Hasan, A. (2017, November). Beauty in a crooked room: Investigating the discourse of black women in pageantry at a predominately white institution of higher education. Paper selected and presented at the Association for the Study of Higher Education (ASHE) Annual Conference. Houston, TX.

Kearns, K., McLinn, C., & White, F. A. (2017, October). Integrating learning-through-diversity in all CIRTL programs. Invited workshop presented at the CIRTL In-Person Meeting at Johns Hopkins University. Baltimore, MD.

Borowski, R., Jordan, T., Korth, C., White, F. A., Dennis, B. Performative accounts of embodied experiences: The transformative act of engaging in feminist research methodology. Paper selected and presented at the International Congress of Qualitative Inquiry (ICQI) Annual Conference. Champaign-Urbana, IL.

Nathan, A., Howell, G., White, F. A., Harris-Hasan, A. (2017, April). Crooked beauty: Analyzing the parameters of black beauty at a predominately white institution of higher education. Paper selected and presented at the American Education Research Association (AERA) Annual Meeting. San Antonio, TX.

White, F. A. (2017, April). Discourse on water in society: A discourse analysis of introductory geography textbooks. Poster selected and presented at the NARST Annual International Conference. San Antonio, TX.

Ozdogan, Z. & White, F. A., (2016, May) Historical and contemporary perspectives on validity in qualitative research. Paper selected and presented at International Congress of Qualitative Inquiry (ICQI). Champaign, IL.

Ozdogan, Z. White, F. & Lester, J. N. (2015, May). The discursive construction of validity in introductory qualitative research textbooks. Paper selected and presented at the International Congress of Qualitative Inquiry (ICQI). Champaign, IL.

White, F. A. & Buck, G. A. (2015, April). Transitioning into science education: A transformative self-study and reflexive approach to understanding equity. Paper selected and presented at the NARST Annual International Conference. Chicago, IL.

Lester, J. N., Ozdogan, Z., & White, F. A. (2015, January). Exploring validity: An analysis of the construction of validity. Paper selected and presented at The Qualitative Report (TQR) Annual Conference. Fort Lauderdale, FL.

<u>Regional and Local</u>

+Williamson, F. A., Peña Palomino, P., Parks, A., Wilkins-Yel, K. A. (2020, March). Integrating social justice and STEM: Engaging advocacy and equity within your field. Workshop presented at the Indiana University Center for Excellence for Women and Technology (CEW&T) Annual Summit. Bloomington, IN.

Wilkins-Yel, K. A., Baker, B., Mukherjee, A., & Williamson, F. A. (2020, March). Mental health and wellbeing: Strategies for thriving as a women of color in STEM. Workshop presented at the Indiana University Center for Excellence for Women and Technology (CEW&T) Annual Summit. Bloomington, IN.

+Willamson, F. A., Donohue, K. & Rosas Vargas, D. (2018, April). GWISTEM's Science Discovery Night. Workshop presented at the Indiana University Center for Innovative Teaching and Learning Conference on Curricular Community Engaged Learning. Bloomington, IN.

Jordan, T., Borowski, R., Korth, C., Williamson, F. A., & Dennis, B. (2016, October). Decolonizing bodies: An interdisciplinary, interactive exploration of feminist research methodologies and practices. Workshop presented at New View Campaign Capstone Conference, Bloomington, IN

White, F. A. & Buck, G. A. (2015, February). Preservice elementary teachers storying their science selves. Paper presented at the Indiana University Science Education Research Symposium. Bloomington, IN.

**Advanced Research Training**

Biology Teaching Assistant Program (BioTAP) Scholar, Cohort 4 2020-2021

Sandra K. Abell Summer Institute, Middle Tennessee State University 2019

Rutgers University Conversation Analysis Laboratory Spring Training Workshops I & II: Turn Taking, Action Sequence, and Preference Organization 2017

Discourse Analysis/Conversation Analysis Research Support Group, Indiana University 2016-2018

## COMMUNITY-ENGAGED SCHOLARSHIP

*Leadership Team Member*, I CAN PERSIST STEM Initiative 2017-Present
Multi-generational initiative designed to support academic success, career persistence, and holistic wellbeing for high school, undergraduate, and graduate girls and women of color in STEM. Founded and directed by K. Wilkins-Yel.
Community partners:
WonderLab Museum, 2019-Present
Bloomington High Schools, Bloomington, IN, 2019-Present
ScienceFest at Indiana University, 2019
Ben Davis High School, Indianapolis, IN, 2017-2019

*Facilitator*, Graduate Women in STEM Teaching Fellows 2017-2019
Community-engaged professional learning community to develop research-based transdisciplinary skills: science communication, teaching, mentoring, and outreach. Designed and developed with K. Donohue.
Community partners:
WonderLab Museum, 2018-2019
Unionville Elementary School/Monroe County School Corporation for Science Discovery Night, 2017-2018

*Partner*, WonderLab Museum of Science, Technology, and Health 2014-2020
Long-term partnership for various service-learning and community-engagement projects.
Projects:
Women's History Month Event on Environmental Justice, 2020
Agents of Change: Women of STEM Leading the Way, 2019
Service-learning with U212 STEMing into IU, 2014-2016

## AWARDS AND RECOGNITION

Mentor of the Year, Indiana University Black Graduate Student Association 2020

Graduate Student of the Year, Indiana University Black Graduate Student Association 2016

| | |
|---|---|
| Woman of Distinction, President's Commission on the Status of Women, Washington State University | 2012 |
| President's Award for Leadership and Service, Washington State University | 2010 |

## GRANTS, FELLOWSHIPS, AND FUNDING

(+ indicates community-engaged scholarship)

**Grants**

| | | |
|---|---|---|
| +Indiana University Women's Philanthropy Leadership Council Grant for the Graduate Women in STEM Teaching Fellows Program, with K. Donohue | $7,000 | 2018-2019 |
| +Indiana University Women's Philanthropy Leadership Council Grant for the Graduate Women in STEM Teaching Fellows Program, with K. Donohue | $15,000 | 2017-2018 |
| E. Wayne Gross Research Grant, Science Education Department Indiana University | $2,000 | 2017-2018 |
| E. Wayne Gross Research Grant, Science Education Department, Indiana University | $2,150 | 2014-2015 |

**Fellowships**

| | | |
|---|---|---|
| President's Diversity Dissertation Fellowship, Indiana University | $20,000 | 2019-2020 |
| Clyde and Bessie L. Lineback Fellowship, Indiana | $1,250 | 2017-2018 |
| Counseling and Educational Psychology Research Fellowship | $1,000 | 2016-2017 |
| Faculty/Maris and Mary Higgins Proffitt Fund Combined Fellowship, Indiana University, School of Education | $64,000 | 2013-2017 |

**Scholarships and Other Awards**

| | | |
|---|---|---|
| Southern Regional Education Board Doctoral Scholars Program Dissertation Award for the Compact for Faculty Diversity's Institute on Teaching and Mentoring | $3,750 | 2019 |
| Curriculum and Instruction Department Travel Award, Indiana University | $300 | 2017 |
| NARST Jhumki Basu Scholar Award | $700 | 2017 |
| Scholarship to attend Rutgers University Conversation Analysis Lab Spring Training Workshops I & II | $200 | 2017 |

| | | |
|---|---|---|
| Bertha Pitts Campbell Special Scholarship for the field of Education, Delta Sigma Theta Sorority, Incorporated | $5,000 | 2016-2017 |
| Center for Research on Race and Ethnicity in Society Graduate Student Travel Award, Indiana University | $500 | 2015 |
| Curriculum and Instruction Department Travel Award, Indiana University | $350 | 2015 |
| National Conference for Race and Ethnicity in American Higher Education Student Scholarship Program | $450 | 2014 |
| E. Wayne Gross Memorial Scholarship, Indiana University | $700 | 2013-2014 |
| McNair Summer Research Experience Funding, Washington State University | $5,074 | 2011 |
| LSAMP Undergraduate Research Scholarship, Washington State University | $1,500 | 2010-2011 |
| Science, Mathematics, and Research for Transformation Scholarship, Washington State University | $3,000 | 2009 |

## TEACHING AND CURRICULUM DEVELOPMENT EXPERIENCE

(+ indicates community-engaged scholarship)

**Undergraduate**

*Instructor*, F401, I CAN PERSIST Undergraduate Seminar — 2019-2020
+Collaboratively developed integrative STEM and social justice curriculum

*Instructor*, L490: STEM Peer Mentoring Seminar — 2015-2017

*Instructor*, U212: STEM, Art, and Creative Inquiry — 2015

*Instructor*, U212: STEMing into IU Service-Learning Course — 2014-2016
+Partnership with WonderLab Museum

*Instructor*, L490: Foundations of Science and Scientific Research — 2014-2016

**Graduate**

*Instructor*, I CAN PERSIST Graduate Scholar Professional Development Seminar — 2019-2020
+Collaboratively developed integrative STEM and social justice curriculum

*Peer Mentor*, CIRTL Peer-Led Teaching-as-Research Online Learning Community — 2019
Provide research support for peers developing teaching-as-research projects.

*Facilitator,* Topics in STEMinism CIRTLCast Series: Women Preparing for Post-PhD Careers in STEM (Part I) and Strategies for Inclusive Undergraduate STEM Education (Part 2) 2017-2018

*Graduate Teaching Intern,* Y650: Ethnomethods and Conversation Analysis 2017

*Facilitator,* Indiana University University-Wide Associate Instructor Orientation Workshop: Managing Authority and Boundaries in the Classroom 2017

*Facilitator,* Learning Community for the Evidence-Based Teaching in STEM CIRTL Network Massive Open Online Course 2017

**K-12**

Balfour Scholars Program STEM Camp, Indiana University 2017
+Partnership with Baxter Medical

Homework Help Program Science and Math Tutor, Bloomington, IN 2016-2017
+Partnership with Bethel AME Church

Fairview Elementary School Tutor, Bloomington, IN 2015-2016

Science of Sustainability Professional Development for K12 Educators, Indiana University 2014

**Guest Lectures and Presentations**

"The Poem Duet on Being Teacher/On Being Student in a Feminist Learning Situation" with B. Dennis, Summer 2017 Y633: Feminist Theory and Methodology and Fall 2018 Y612: Critical Qualitative Research Methodology graduate inquiry courses

"Beauty in a Crooked Room: Investigating the Discourse of Black Women in Pageantry at a Predominately White Institution of Higher Education" with A. Nathan, G. Howell, and A. Harris-Hasan, Summer 2017 Y633: Feminist Theory and Methodology graduate inquiry course

"Doing Discourse Analysis," Spring 2017 Y631: Introduction to Discourse Analysis graduate inquiry course

"Discursive Psychological Approach to Analyzing STEM Recruitment Videos," Spring 2017 Y631: Introduction to Discourse Analysis graduate inquiry course

## PROFESSIONAL SERVICE AND LEADERSHIP

**International and National**

*American Educational Research Association* 2015-Present
Member, Qualitative Research Special Interest Group Membership Committee, 2019-Present

Roundtable Chair, “Perspectives and practices of narrative inquiry in educational research,” 2015 Annual Conference, Chicago, IL
Reviewer, Science Teaching and Learning SIG conference proposals, 2015
Reviewer, Qualitative Research SIG conference proposals, 2014-2015, 2017

*NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research* 2014-Present
Member, Research Methods RIG Steering Committee, 2019-Present
Graduate Student Representative, NARST Executive Board, 2017-2019
Member, Equity and Ethics Elections Committee Representative, 2016-2017
Planning Team Member, Equity and Ethics Committee Pre-Conference Workshop, 2014-2015
Member, Equity and Ethics Committee, 2014-2017
Reviewer, Strands 5, 9, and 11 proposals, 2014-Present

*Reviewer* 2014-Present
Complementary Methods for Educational Leadership and Policy Studies, 2017
Qualitative Inquiry Special Issue: “Reclaiming” Disability in Critical Qualitative Research, 2016
Journal of Research on Leadership Education, 2016
Education Policy Analysis Archives - EPAA/AAPE, 2016
Journal of STEM Education, 2015-Present

*Annual Biomedical Research Conference for Minority Students* 2014
Poster Session Judge, Social and Behavioral Sciences and Public Health Category, San Antonio, TX

**Regional and Local**

*Diversity Emissary*, The University Graduate School Diversity Emissary Program, Indiana University 2017-2018

*Planning Committee Member*, Discourse Analysis in Education Conference, Indiana University 2016-2017

*Treasurer*, School of Education Graduate Student Association, Indiana University 2016-2017

*Executive Board and Committee Member*, Black Graduate Student Association, Indiana University 2013-2016

*Graduate Student Member*, Bloomington Faculty Council's Diversity and Affirmative Action Committee, Indiana University 2013-2014

## PROFESSIONAL ORGANIZATIONS AND AFFILIATIONS

American Educational Research Association
Association for the Study of Higher Education

Delta Sigma Theta Sorority, Incorporated
Ecological Society of America
NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research