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Becoming a Math Teacher:
Recruitment, Preparation, and Practice

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Abstract

Becoming a Math Teacher: Recruitment, Preparation, and Practice

Dena M. Sexton

One of the prevailing concerns in education is student access to well-qualified teachers. This concern is particularly acute in the case of California math students where one of out of every six teaching in high minority middle and high schools is considered under-prepared, compared to one of twenty in high-achieving schools. Math, as a content area in schools, is often considered a gatekeeper subject. Limited access to qualified teachers only adds to America's already inequitable social stratification. As a potential barrier to higher education and employment, school math – and those who teach it -- play critical roles in the future of students' lives.

Empirically, we know very little about why people select math teaching as a career or the role of recruitment and preparation programs in their early development and career plans. Longitudinal research is needed to examine the relationship between recruitment and preparation and *who* and *how* one becomes as a math teacher. This dissertation uses the concept of "teacher identity"—conceptualized here as both the process through which one develops as teacher and the product, both *how* and *what* or *who* — theoretically and analytically to help reveal this process. Specifically, in this study I examined three teacher candidates' developing teacher identities as they participated in a year-long teacher education program and the subsequent first five years of their teaching career.

The recruitment and teacher credentialing processes are of particular importance in this study; the credential program partnered with the candidates' undergraduate math major and pre-professional program which had as its aim to increase the number and retention of qualified math and science teachers. Expanding entry and retention were critical parts of the social worlds and discourses through which these candidates entered teaching.

Data collection focused primarily on interviews over six years (from preservice education to the candidates' fifth year in the classroom) and also includes survey, participant observation, and document analyses. This study draws on sociocultural perspectives to attend to the socially constructed and culturally figured aspects of identity though language and interactions in educational contexts.

This research contributes to a theoretical understanding of teacher identity as dynamic, shifting, and developed in relation to self, others, and context. It attends to the gap of empirical literature on math teacher identity specifically, with attention to conceptions of subject mastery as an exclusive property. Relationships between the beginning math teachers' biographies and perceptions of themselves as students were critical as they grappled with their fit with math teaching in general and the schools where they taught more specifically, as well on their perspectives on the students they taught and what comprised a 'good' math student.

A few discursive and contextual factors appeared to be central to their teacher identity development: the logic of recruitment for a high-need subject area, the role of field experience in preservice and teacher preparation, as well as the contexts of

schools as workplaces with specific cultures and perspectives on what constitutes good students and teachers. These drew attention to the situated process of developing a teacher identity and, consequently, one's career trajectory.

This dissertation addresses this and theorizes a relationship between now and then, as articulated by the candidates. This is presented along with longitudinal data to compare their early anticipations with lived through outcomes. This study confirmed previous findings on the importance of person-organizational fit in the teachers' choice of whether to teach or stay at a particular school. However, commitment to teaching and teaching at particular sites did not necessarily equate to particular modes of instruction (e.g. teaching for equity as is attended to in this work).

Practice recommendations focus attention to field-based teacher education programs as one remedy to the current disjuncture between the historically and empirically ineffective theory-practice divide. I advocate for more attention to hybrid teacher preparation programs that reposition fieldwork and field-based knowledge and perspectives such that practice and theory are iterative and integrated across the sites of teacher preparation rather than divided and contested. This is both a practical and cultural shift.

In tandem with current research on mentorship, I recommend rigorous attention both pragmatically and empirically to the role that cooperating teachers and teacher supervisors play in teacher development and careful analysis of the kinds of support provided to them, implementation of mentoring strategies, as well as a better understanding of how they are selected by universities as well as school districts.

Dedication

To all the teachers and cultural workers that,

as Adrienne Rich wrote,

"*age after age, perversely, with no extraordinary power, reconstitute the world*."

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Chapter One: Math, Math Teachers, and Educational Equity

"In framing questions related to equity, broader contextual factors become central features of the analysis… Each of us has a responsibility to both think about and act on issues of equity" (Gutstein, Fey, Heid, DeLoach-Johnson, Middleton, Larson, Dougherty, & Tunis, 2005, p. 98).

Introduction

One of the prevailing concerns in education is student access to well-qualified teachers. In California, the lowest performing schools – frequently those with the highest distributions of poor and minority students, as well as English learners – often have the least prepared teachers. This is particularly true in the case of California math teachers where one of out of every six teaching in high minority middle and high schools is considered under-prepared, compared to one of twenty in high-achieving schools, (California Council on Science and Technology and The Center for the Future of Teaching and Learning, 2007). Moses and Cobb (2001) in their work on access to math education as a civil rights issue described math as a kind of 'critical filter' implicated in the social stratification of communities. Tate and Rousseau (2002) in their review of the social and political contexts of mathematics education found that participating in university-track math courses had a significant impact on students' socioeconomic futures. As a potential barrier to higher education and employment, school math – and those who teach it – play critical roles in the future of students' lives.

Math as a Gatekeeper

Math has been understood and treated as a gatekeeper subject throughout the history of formal schooling. Stinson (2004) in his review of the history of equity and math education traced this phenomenon back to the time of Plato's Republic where advanced mathematics were reserved for the 'philosopher-guardians' of the city; essentially, the ruling class.

Although Plato believed that mathematics was of value for all people in everyday transactions, he argued that the study of mathematics that would lead some men from "Hades to the halls of the gods" (p. 215) and should be reserved for those that were "naturally skilled in calculation" (p. 220); hence, the birth of mathematics as the privileged discipline or gatekeeper." (Stinson p. 9, page numbers refer to 1996 translation of Plato's Republic).

This divide is still found in math classrooms today – and, in different ways, in the perspectives of the math teachers that are the subject of this research – specifically that there is a commonly held perspective that math competence is an exclusive property. Among the candidates that were that were the focus of this research was the perspective that there is a kind of inherent skill set that predisposes a person to understand and excel in math and that this knowledge should position students in particular ways. This was often held in contradiction to their simultaneous position that all students can and should learn math. I will address this contradiction in their perspectives in this dissertation.

This is not just an ontological divide but also a phenomenological one. Over time, these philosophical perspectives of math led to policy- and school-based codifications of math as an exclusionary subject. Stinson referred to Stanic's (1986) historical review of math education in the United States to make connections from Plato's time to the present day. In his summary of Stanic's work, Stinson noted that math became a separate field of study in schools in the 1890's and was at risk of being removed from the mainline subject offerings. Four perspectives on education were dominant at the time (humanists, developmentalists, social efficiency, and social meliorists). *Humanists* focused on traditional disciplines from Western philosophy (math was one of these), *developmentalists* focused on the 'natural' development of children, *social efficiency educators* focused on a natural order which they argued created the social stratification such that disadvantage was taken to be biological rather than situational or institutional, and *social meliorists* proposed education as a means for social justice (Stinson, 2004, p. 9).

Math educators sided with humanists to argue that 'mathematics should be an important part of the school curriculum' (Stanic, 1986 p. 193). In fact, the National Council for Teachers of Mathematics (NCTM, also more recently responsible for advocating a revisioning of math education in schools) was developed in 1920 partly in response to debates about the role of math in schools. It is important to note the distinction of math as canonical (a la humanists) rather than something that could be leveraged for social change (social meliorists). This framing of math, despite policy and curricular interventions, endures and is found in the perspectives of those who

participated in this research. It focuses the notion of math competency as a kind of property (something you have or do not) without questioning how or why this might be.

At the same time as these debates occurred, the demographics of public schools in the United States were shifting. More students attended school than ever before in the United States. The overall school population grew by almost twenty times between 1890 and 1940. This expansion included a wider range of racial and gender groups – which, in part, led to beliefs that students were less intellectually capable than they had once been. Again, although this happened nearly one hundred years ago, the concerns raised are quite similar to those described by the teachers that are the subject of this research. This becomes particularly salient in chapter six and the discuss of the ways that early exposure to teaching, with minimal oversight, often served to calcify existing deficit framings of students and a propensity towards didactic modes of instruction.

Stanic (1986) referred to the results of the 1933 National Survey of Secondary education, which concluded that less than half of the secondary schools required algebra and plane geometry. He illustrated mathematics teachers' perspectives by providing George Counts' 1926 survey of 416 secondary school teachers – eighteen of the forty-eight mathematics teachers surveyed thought that fewer pupils should take mathematics, providing a contrast to teachers of other academic disciplines who believed that "their own subjects should be more largely patronized" (G. S. Counts as quoted in Stanic, p. 196).So, while teachers of other subjects felt that more students

should take courses in their area, math teachers suggested that fewer should enroll in math. The historical legacy of restricted and exclusive access to math is poignant.

However, it was not until the 1950's with the launching of Sputnik and general critiques from the U.S. business and military sectors on high school graduates' lack of computational skills, that this curricular discussion became a national, politicized one. Since that time, we have seen decades of math education reform from "the 'new' math of the 1960s, the 'back-to-basic' programs of the 1970s, and the "'problem-solving' focus of the 1980s" (Stinson, 2004, p. 10). Through these reforms, questions surfaced not only of what and how to teach but, also, *who should be taught*. As Oakes (1985) noted in her work on tracking and de-tracking students, those debates led to increased tracking of students in math by perceived ability which often excluded female students, poor students, and students of color from advanced math courses.

In 1989, the NCTM published new Mathematics curriculum standards which prioritized math literacy and competency to redress social inequalities for all students. They wrote,

> The social injustices of past schooling practices can no longer be tolerated. Current statistics indicate that those who study advanced mathematics are most often white males… Creating a just society in which women and various ethnic groups enjoy equal opportunities and equitable treatment is no longer an issue. Mathematics has become a critical filter for employment and full participation in our society. We cannot afford to have the majority of our population mathematically illiterate: Equity has become an economic necessity. (p. 4)

The NCTM standards (1989) addressed the exclusionary aspects of math by shifting the curriculum to more clearly address technological shifts and alter societal goals to

have "a school system organized to serve as an important resource for all citizens through their lives (p. 3). As Stinson (2004) wrote, this "required those responsible for mathematics education to strip mathematics from its traditional notions of exclusion and basic computation and develop it into a dynamic form of an inclusive literacy, particularly given that mathematics had become a critical filter for full employment and participation within a democratic society" (pp. 10-11). These findings have been quantitatively verified in numerous reports (c.f. *Mathematics Equals Opportunity* and *Do Gatekeeper Courses Expand Education Outcomes?*). Given its gatekeeper status, how can all students have access to advanced math instruction? As Bowles (1971/1977) argued, schools respond to capitalism which requires both skill development and the reification of the class structure. Even when equality is the goal, it falls short from equitable goals for students.

This movement to transform mathematics teaching and learning, launched by the NCTM in the late 1980s, stimulated a large body of research focused principally on the professional development and classroom practice of experienced teachers. This body of research demonstrates the benefits of intellectually ambitious, equity-oriented mathematics instruction, while also underscoring the challenges that teachers and teacher educators confront in achieving it (Horn, 2007; Louie, 2015, 2016; Nasir et al., 2014). This combination of benefit and challenge has inspired efforts to prepare novice teachers and spawned a growing line of research for example, Lampert et al., 2013). However, this research foregrounds the development of pedagogical practice and principles, with less attention to identity formation.

Equality and Equity: Parsing out the Distinctions

This dissertation focuses on the longitudinal experiences of three beginning math teachers and is in conversation with the larger project of math education, in general, and equity in math education, specifically. If we are to conceive of a math education that has the potential to disrupt existing social stratification, some clarity in terms is needed, specifically the differences between equality and equity. Conceptions of equity vary across the field. As Gutierrez (2013) noted in the introduction the equity special issue of the *Journal of Research in Mathematics Education*,

> [a]lthough the theoretical framings of equity in mainstream mathematics education tend to reflect equality, rather than justice, static identities of teachers and students rather than multiple or contradictory ones, and schooling rather than education, the increased attention to equity-related issues is palpable" (p. 38).

Equality in math education is the notion that, minimally, all students have access to similar math curricula and 'fully qualified' teachers is important and has been used to frame many policy responses to the currently unequal distribution of these resources. However, an equity framework moves from notions of sameness to one of reparation such that students' needs are met in a way that redresses the current and historical injustices, allowing for not just equal inputs but prioritizes equitable outcomes.

This dialectic between equality and equity is particularly important when considering disparities in access to teachers. While an equality framework allows a focus on supplying students with credentialed teachers (an important but also insufficient lens) – an equity framework asks that we look at what is made possible and for whom through the people, pedagogies, curriculum, and school contexts. Both

equality and equity are important to address when considering the recruitment, preparation, and career paths of teachers.

Math education scholars agree that students of color, and those from lower socioeconomic backgrounds, do not have equitable access to a quality education (c.f. Frankenstein, 1995; Moses & Cobb, 2001; Secada, 1995; Stinson, 2004; Skovmose, 1994; Tate, 1995). Access to a quality math education is approached most commonly from an understanding of the achievement gap between white students and students of color, and higher SES to lower SES students. The assumption guiding much of the recruitment-focused policies is that access to "qualified" math teachers will produce more equitable outcomes such as expanded access to higher education and economic mobility. Or another way to say this would be that giving all students what most white, middle class students generally already have (access to qualified teachers) will produce equitable outcomes for all. This understanding of equity guides current approaches to recruitment – to bring those with majors or minors in math or math education to the field.

However, others question the larger social and political project of mathematics education (Martin, 2009; Gutierrez, 2013; Gutierrez & Dixon-Roman, 2011; Gutstein, 2006). As Gutierrez (2013) noted, "mathematics still is largely regarded as a discipline devoid of human influence" and that preservice teachers often view themselves "as 'teachers of math' not 'teachers of students'" (p. 57). This decontextualized perspective on math has led to recruitment policies that privilege content knowledge over, rather than in tandem with, commitments to teaching

underserved students. Access to qualified teachers is certainly a worthwhile goal but it is not necessarily reparative of the current and historical issues in schooling that excluded women and students of color from this accessing and excelling in this subject area.

Math Teacher Shortage

There has been a shortage of qualified math teachers in the United States for decades (c.f. Boe & Gilford, 1992; Ingersoll & Perda, 2010; Sutcher, Darling-Hammond, & Carver-Thomas, 2016). Even as the queue of qualified teacher candidates expands, attrition remains high (Darling-Hammond & Sykes, 2003; Ingersoll, 2000, 2001; Ingersoll & May 2011). These issues are compounded by an already inequitable distribution of teachers. As noted earlier, schools which serve "the highest proportion of poor and minority students and English-language learners struggle more with attracting and retaining fully prepared teachers" (California Council on Science and Technology and The Center for the Future of Teaching and Learning, 2007, p. 23). The issue is particularly acute among math teachers in the counties surrounding Cliff University, the region that is the focus of this study. At the start of this study, an analysis of the local teaching workforce revealed that one-third of math teachers were not fully qualified according the NCLB[1] standards. When analyzed by classes taught (rather than by school), findings were more bleak. Only

[1] Data collection for this dissertation began in 2009.

one half of the math classes were taught by fully qualified teachers and, worse, only 30% of the lower track classes were taught by qualified math teachers.

To become a teacher in California, candidates are required to complete a post-baccalaureate program which authorizes them to teach in their subject area. Although alternative routes are expanding, most math teachers are prepared through university teacher education programs. Only about 1% of STEM teachers in California are prepared through blended programs, where formal teacher preparation begins during the undergraduate years. State level analyses, such as the one offered by the California Council on Science and Technology and The Center for the Future of Teaching and Learning (2007) show that the existing university programs do not have the capacity to produce enough math (or science) teachers to meet the projected need.

Sutcher, Darling-Hammond, and Carver-Thomas (2016), in their analysis of teacher supply, demand, and shortages, found that math and science credentials continued to decline in California even as supply in other teaching areas improved. They noted that these teachers also "move schools and leave teaching at higher rates than humanities teachers and general elementary teachers" (p. 44). This is further exacerbated at "high-poverty, high-minority" schools which experienced the highest teacher turnover across teacher demographic groups.

Math Teacher Recruitment, Preparation, and Retention

The need for math teachers, nationally and locally, is clear. Policy efforts generally focus on pipeline issues such as recruitment and preparation, despite minimal evidence that this particular policy lever will make a dent in staffing issues.

Although there is a long history of financial incentives under the National Defense Education Act (NDEA) of 1958, little is known about their influence on recipients (Liou, Kirchhoff, & Lawrence, 2010). Guarino, Santibañez, and Daley (2006) in their review of teacher recruitment and retention, wrote that the "literature on pre-service policies is fairly sparse, with the exception of studies that focus on nontraditional and alternative certification programs" (p. 195). Recruitment efforts based in financial incentives have produced mixed results with respect to supplying teachers to high-need schools (Liu, Johnson & Peske, 2004; Little & Bartlett, 2010). However, the Teach STEM participants credited the financial inducements with drawing them to teaching, and two of the three case teachers remain in high-need schools after eight years.

Ingersoll and Perda (2010), in their analysis of national teacher staffing databases, found that although recent recruitment efforts yielded an increase in qualified STEM teachers, vacant positions exceeded supply due to high turnover. STEM teachers are twice as likely to leave teaching because of dissatisfaction than others – 40 percent of math and science versus 20 percent of all other teachers (Ingersoll, 2000). In their research report on teaching workforce trends, Ingersoll, Merrill, and Stuckey (2014) identified teacher turnover as "a major factor behind the problems that many schools have staffing their classrooms with qualified mathematics, science, and other teachers" (p.26). Additionally, they noted that "[i]ncreases in turnover among minority teachers, especially in disadvantaged

schools, undermine efforts to recruit new teachers in hard-to-staff schools and to diversify the teaching force" (p. 26).

Empirically, we know very little about why people select math teaching as a career or the role of recruitment and preparation programs in their early development and career plans. Qualitative and longitudinal research is needed to examine the relationship between modes of recruitment and preparation and retention patterns.

Focus on recruitment

Given the importance of school math and the currently inequitable distribution of "qualified" math teachers, it is interesting to note that policies intended to solve these staffing issues tend to focus on recruitment and preparation rather than retention. Guarino, Santibañez, and Daley (2006), in their review on teacher recruitment and retention, found that the research base on the influence of preservice policies on recruitment and retention is incomplete. As Little and Bartlett (2010) noted in their chapter about the teacher workforce and issues of educational inequality,

> Four policy responses [to the problem of teacher quality]— financial incentives, alternative pathways to certification, a reliance on short-term workforce participation, and the use of overseas-trained teachers—are indicative of the ascendance of market logics in the pursuit of teacher quality. These responses tend to demonstrate a greater emphasis on recruitment than on retention and to reflect a conception of workforce quality that centers on individual characteristics and choices. (Little and Bartlett, 2010, p. 314)

Ingersoll and Perda (2010), in their analysis of national teacher staffing databases, found that although recent recruitment efforts yielded an increase in qualified

Science, Technology, Engineering and Mathematics (STEM herein) teachers, vacant positions exceed supply due to high turnover. STEM teachers are more likely to leave teaching because of dissatisfaction than others – 40 percent of math and science versus 20 percent of all other teachers (Ingersoll, 2000). So, while retention has been identified as a primary reason for the persistent math teacher shortage, supply side responses are still the dominant approach.

Even though this is true, little is known about the utility of current recruitment efforts. Who is attracted to math teaching as a result of these efforts? How do early exposure programs influence candidates' early development and perspectives on math teaching? What are their short- and long-term career plans? There are conflicts between policy approaches and empirical work on the draw of teaching. For example, the empirical literature indicates that extrinsic reasons, such as financial incentives, are less influential on choosing teaching as a career than altruistic or humanistic reasons (e.g. Johnson & Birkeland, 2003; Moran, Kilpatrick, Abbott, Dallat, & McClune, 2001; Lortie, 1975; Achinstein, Ogawa, Sexton, & Freitas, 2010). Also, teachers of all ethnicities tend to leave schools traditionally deemed 'high-need' for those with lower percentages of minority students, students of higher socioeconomic status, and better wages (Ingersoll, 2001; Lankford, Loeb & Wyckoff, 2002).

So, while important concerns about *quantity* and *qualifications* dominate conversations about math teachers, a crucial shift is needed to focus on the *quality, distribution,* and *perspectives* of these teachers. For example, while the program successfully recruited and retained qualified math teachers, there was also more of a

focus on traditional math teaching and minimal disruption of deficit thinking about students.

Math Teacher Retention

Codifications of being 'effective' or 'high-quality' mathematics teachers are generally drawn around lines of subject competency in mathematics or narrow versions of pedagogy which fail to capture the dispositions and commitments needed to support marginalized students in math. Rice, Roellke, Sparks, and Kolbe (2009) in their typology of multi-level teacher policies (e.g. state, district, and school levels) found that the kinds of shortages a school or school district faced determine whether their emphasis is on supply-side issues or if they focused on retention. They wrote,

> districts and schools with a shortage of highly qualified teachers, as externally defined by federal and state criteria, are focused on policies to attract and retain teachers with those qualifications. In contrast, districts and schools that enjoy a surplus of teachers who meet the externally imposed requirements are free to draw on a different set of policies that emphasize teacher quality, as defined by their effectiveness (or potential effectiveness in the case of recruitment) in the particular context (p. 537).

So, those schools and districts that have the hardest time staffing in shortage areas, such as math, tend to focus on qualifications-based policies, where those with a surplus tend to focus on quality-based policies. Inequitable distribution of math teachers creates a paradoxical approach to hiring and development where, on one side, the focus is primarily subject matter competence and appropriate credentialing while the other privileges depth and teacher development. This mirrors the argument that Achinstein, Ogawa, and Speiglman (2004) posed about school district hiring and

new socialization creating separate tracks of teachers. They wrote that the different ways that schools and school districts hire and support their teachers results in the

> socialization of novices [that] may produce high and low tracks of teachers whose instructional beliefs and practices enact inequities in the socialization of high- and low-track students. These tracks correspond with the capital of the district, thus ensuring that the "rich" (high capital) get richer and the "poor" (low capital) get poorer. This method of reproducing inequality is less obvious than student tracking but all the more troubling. The reason is that teachers, the trusted purveyors of education, embody and enact curricular and pedagogical inequities. New teachers, under current socializing forces, can become agents in the reproduction of social inequality. Thus, two classes of teachers for two classes of students and communities emerge (p. 594).

Given the incongruence of policies to meet the staffing needs which may actually exacerbate existing inequity, I propose that my work here is to understand recruitment beyond supply issues and inquire about relationships between recruitment, preparation, and early teacher experiences on early career development and decision making, including one's orientation towards teaching math. In part, I found that the teachers in the study were both tracked by site and reproduced a kind of tracking through their perspectives on students and themselves as teachers, preferring to work with those students who were normatively successful in math and the families who were able to support these capacities with apparent ease.

Empirically, we know very little about why people select math teaching as a career or the role of recruitment and preparation programs in their early development and career plans. Research focused specifically on the intersections among math teacher recruitment, preparation, and career plans is limited at best. For example, while we know that some recruitment efforts have been successful in drawing

qualified candidates to teacher preparation programs, very little is known about those teachers' career plans. More importantly, do they plan to teach in the places where the need for qualified (and quality) math teachers is most critical? If so, how long do they remain? These questions begin to address long held quantity concerns. Addressing them leaves room to explore critical concerns about quality, teacher practice and development over time, and commitment. The research for this dissertation sits at the nexus of these inquiries.

Introducing the Dissertation

I focused my dissertation research on three mathematics teacher candidates from one California teacher recruitment and preparation program to explore the central research question: *how do beginning math teachers develop a professional identity?* To answer that question, I focused on a few related questions: How are pre-service and early career mathematics teachers working in schools constituted as teachers? How did they come to understand the subjectivities/positions available to them as beginning math teachers? How did this shape their perspectives of math, math teaching, and themselves as math teachers? Given the duration of this study, this meant attention to the beginning math teachers from the very start of pre-service teacher education where their shared perspectives developed, in part, through their undergraduate teaching experiences through the end of their fifth-year teaching.

I chose identity as an analytical heuristic to attend to the simultaneously holistic and situated dimensions of teacher development. The focus is on inter-relationships between *who they are* as individuals and the *ways they are shaped* by

those contexts in which they participated. One of the important strengths of this analytical framework is the capacity to explore, rather than reduce, complexity. This is needed for math education in particular because, as Gutierrez (2013) noted in the introduction to a special equity-focused issue of the *Journal of Research in Mathematics Education* "while 'equity' has become a hot topic in mathematics education, the theoretical underpinnings, epistemologies, and methodologies employed still lag far behind other disciplines" (p. 22). I address this lag with a robust theoretical and analytical framework. In Chapter two I argue that teacher identity, as a heuristic for development, challenges the existing narrow understandings of entry, development, and career plans for beginning math teachers.

The research sites for my study included the dual (and sometimes competing) contexts of teacher preparation: the university setting and the local schools where the candidates completed their practicums as well as those schools where they were later employed. Through their funding and teacher preparation program, there was an explicit focus on teaching math to students in "high-need" settings. However, despite the common focus, the way each program organized and presented math teaching as a career differed. All of the candidates received a competitive STEM teaching fellowship, which required two years of service in a high-need[2] district in exchange for the funding.

[2] High need refers to schools with some combination of teacher turnover, low SES, and/or high percentage of English learners.

The primary data source for this research was the seven open-ended intensive interviews conducted from the outset of the candidates' teacher preparation program through the fifth year of their teaching. Questions posed focused on their life histories, pre-professional experiences (including recruitment and their reasons for selecting teaching), experiences in the preparation program and at the schools where they were later employed, understandings of math teachers and their work, their developing practices, perspectives on themselves as teachers, on induction, collaboration, their sites, and their short- and long-term career plans. Other data collected include an open-ended survey; observations of the teacher candidates both at the university and in their student teaching during the preservice year; and document collection (from the university, the schools where they did their practicums, and those produced by the students themselves). For data analysis, I undertook iterative phases of content analysis, open coding, axial coding, analytic and comparative memos, and cross-case analyses (Bogden & Biklen, 1998; Charmaz, 2003; Charmaz, 2014; Clarke, 2005).

Understanding the entry, development, and career plans of these teachers will allow us to begin to explore the utility of recruitment efforts and teacher preparation focused on preparing teachers to teach in diverse settings. As more and more financial and human resources are spent on drawing people into the field of math teaching, it is critical to explore why people choose math teaching and the role recruitment plays in that. While we certainly need to expand our supply of well-prepared math teachers, the focus of this dissertation is not one of quantifying supply and demand issues;

here, the focus is the qualitative how and why questions focused on entry to the profession, perspectives on teaching practice in the first five years of the candidates' careers, and early career decisions. In this dissertation, I explore how these policy and institutional frameworks also shaped the beginning teachers' perspectives on math teaching.

Findings and Chapter-by-Chapter Preview

The three beginning teachers who are the subject of this research all entered teaching through a recruitment pathway (as discussed in chapter four) that privileged early exposure to teaching as well as funding to cover their credentialing and master's education. Each taught in a school identified as high need for at least two years and, after five years in the classroom, two of the three were still teaching with varying ways to conceive of their commitment to the profession. So, there is some evidence to suggest that these programs were successful in drawing in candidates who completed their credential, taught for at least two years in a high need setting, and stayed beyond the oft-referenced five-year mark. What this study offers, however, is a more in-depth analysis of the three beginning math teachers from the start of teacher preparation (referential to their prior life and schooling experiences as well as undergraduate early exposure program) through their fifth year of teaching after earning the credential.

In Chapter Two I review literature relevant to the topic of teacher identity and outline the theoretical and analytical framework for this study. The research here is rooted in social practice theories of identity with an analytical eye towards the ever-

evolving discourse on teacher professional identities, in that way it moves across individually held identities, those locally practiced and developed in the teacher preparation program and schools, as well as dominant discourses on professional identities. In this chapter, I outline teacher identity as a useful heuristic by addressing relevant empirical and theoretical literature.

In Chapter Three I present the methodology and research methods. For this project, I focused on using some of the qualitative methods that emerged from the integration of symbolic interactionism and cultural studies, such as grounded theory, as well as discourse-specific analytics to examine the influences and processes of teacher identity development as the candidates moved from their preservice program through their fifth year of teaching. I collected qualitative data from a variety of data sources and conducted a four-phase analysis. Chapter Three also describes my roles as a researcher and the limitations of the study.

Chapters four through six present findings from the candidates' perspectives and discussion. These chapters take a detailed look at the three focal students through participation in the recruitment and early exposure program, the teacher preparation program and school sites over the course of the study.

Chapter four is primarily a descriptive chapter focused on the undergraduate and preservice teacher preparation programs that the beginning math teachers participated in as unique kinds of recruitment sites. This is one context that policy makers expect will produce and/or maintain the needed supply of math teachers. This chapter describes existing math teacher recruitment programs and helps to situate the

candidates' experiences analyzed in the subsequent three chapters. Chapter Four focuses on observation, document collection, and interviews on early program experiences; while chapters five and six focus primarily on the candidates'/teachers' experiences and perspectives over time.

Chapter five profiles each of the focal candidates with attention to their own biographies prior to the teacher education program, their reasons for selecting math teaching as a career and pathway towards their credential, as well as their first five years of teaching. Explored here are the beginning math teachers' perspectives on a wide range of relevant topics as they shifted (or not) over the six years of the study.

Attending to the situated aspects of teacher identity pointed to ways that identities were held in common and/or experimented with in the context of the preparation program and the schools where the candidates were employed. Similarly, Ronfeldt and Grossman (2008) in their work on possible selves and teacher identity located provisional selves as "those possible selves that are actually tried out in professional education… through experimentation with provisional selves in professional education, novices determine which possible and provisional selves are helpful in adapting to new roles" (p. 43). For the current research, there was particular attention on the candidates' positioning and authoring in the social worlds of math teacher recruitment, preparation, and practice. One salient finding here was that the extended career preview time – an aspect of their recruitment program which extended the apprenticeship of observation – tended to calcify rather than disrupt

existing perspectives in math teaching and learning. The transition from student teacher to instructor of record was a crucial, shaping one.

In chapter six, I address the findings from chapters four and five. The discussion here focuses on (1) the enduring effects of the apprenticeship of observation and (2) the constraints of cultural match ideologies in teacher recruitment strategies. In chapter seven, I provide program implications focused on the limitations and affordances of early recruitment and exposure programs and outline ideas for future research that extend from this research.

Chapter Two: Teacher Identity as Theoretical and Analytical Lens

"The image of teaching advocated here is dialogic: teaching must be situated in relationship to one's biography, present circumstances, deep commitments, affective investments, social context, and conflicting discourses about what it means to learn to become a teacher" (Britzman, 2003, p. 31).

How Do Novices Become Teachers?

Over the past fifty years, teachers and teacher learning have been important domains in the empirical literature in education. Beginning in the 1970's, inquiry from a behaviorist perspective attended to what teachers do in the classroom (c.f. Rosenshine, 1971; Dunkin and Biddle, 1974). Scholars working in this line of research often codified and quantified teachers' observable behaviors. Researchers such as Doyle (1977) argued that while this research led to a better understanding of student-teacher interactions with some implications for student learning that, because the object of study was limited to class interactions, it missed the broader ecology of schools, teachers, and teaching. Over time this line of research broadened to include cognitive domains.

Cognitive research built on the idea that what teachers do is affected by what – and how – they think. Research on teacher thinking drew on teacher self-report and commonly employed psychological frameworks to understand not only what teachers do, but the relationship between teacher behavior and teacher thinking (Clark & Peterson, 1986). Research in this area included empirical work on teacher planning, teacher judgment, teacher decision-making, and teachers' implicit theories or perspectives (Clark & Yinger, 1977, p. 280).

In the 1980's, research on teachers broadened to explore teacher knowledge. Perhaps best known was Shulman's work on knowledge for teaching (c.f. 1986, 1987). He argued that content knowledge and pedagogy were not mutually exclusive domains and that, "the teacher is not only a master of procedure but also of content and rationale, and capable of explaining why something is done" (1986, p. 13). His work emphasized the complex knowledge base required for teaching. Pedagogical content knowledge (PCK), which attended to the learning about teaching that came from formal learning, teaching practice itself, and reflection on practice, was one of his most notable contributions.

Research on teachers and teacher learning expanded again in the 1990's to address teachers' lived experiences. While teacher knowledge was taken to be explicit and analytical, concepts such as teachers' lives and beliefs were seen as more implicit and intuitive, developed experientially by 'doing' things. This is evidenced in concepts such as 'personal practical knowledge' (Connelly, Clandinin, & He, 1997) in which understandings of teaching come from the teachers themselves. These are personal accounts concerned with how teachers understand themselves and their work in schools. There was an emphasis on life history and narrative research methods to explore the relationship between personal lives and teacher practice (Clandinin & Connelly, 1994, 2000; Cole & Knowles, 2000; Goodson & Walker, 1991; Huber & Whelan, 1999). This is what MacLure (1993) termed a "biographical attitude," privileging teachers' lived experiences as fundamental to who they are, and would

become, as teachers. While narrative and 'lives of teachers' research permeated the field, very little appeared in accounts of math teachers specifically.

For math teachers, research bridging the personal and professional during this time period was more apparent in the teacher beliefs literature. This line of research followed the assumption that teachers' beliefs guide their actions. While Nespor (1987) argued that beliefs have a stronger impact on action than knowledge, others, such as Clark and Peterson (1986) presented beliefs as a kind of filter that guides teacher decisions so that they rely on their knowledge as mediated by their beliefs. It was not unidirectional as researchers (c.f. Pajares, 1992) found that teachers' beliefs were themselves influenced by both internal and external factors. Using this construct, a number of studies located the disjuncture between actual practices and hoped-for practices in beliefs (Erickson, 1993; Cooney, 1985; Raymond, 1993).

For example, Ernest (1989) in a study of math teacher beliefs found that teachers with similar knowledge backgrounds still taught differently and attributed that difference to beliefs. For preservice math teachers, studies showed that their beliefs were often more traditional than progressive in terms of math teaching (c.f. Foss & Kleinsasser, 1996) and that even in the face of changed or changing beliefs, they often struggled to implement more progressive pedagogies (c.f. Van Zoest, Jones, & Thornton, 1994). Handal (2003) summarized the findings in this area and found that "preservice [math] teachers bring into their education program mental structures overvaluing the role of memorization of rules and procedures in the learning and teaching of school mathematics" (p. 50). These traditional visions of

math pedagogy contradict pedagogies associated with the preferred 'reform mathematics' which privilege process over rote memorization.

Teacher beliefs offered the field of education (and math education in particular) a heuristic to connect personal and professional aspects of teachers and teaching. Locating the teacher as a multi-dimensional focus of inquiry broadened the field beyond narrow subject-only conceptions. This research not only expanded epistemological awareness with updated methodologies and empirical categories such as self and personal histories but allowed for deeper ontological awareness of teachers as whole rather than partial, engaged participants rather than mere instruction deliverers. These were necessary precursors to the currently popular and innovative field of study – teacher identity. Although there is a large literature on beliefs, scholars such as Pajares (1992) argued that there were definitional issues and that researchers "defined beliefs in terms of their own agendas" (p. 326). Also, this line of research positioned knowledge and beliefs as something that teachers have and apply to their teaching, rather than situated in the teaching context itself. Geertz (1973) claimed that beliefs merged "extreme subjectivism to extreme formalism, with the expected result: an explosion of debate as to whether particular analyses . . . reflect what [people] 'really' think" (p. 11). Sfard and Prusak (2005) wrote that "[t]he issue at stake was that of the essentialist vision of beliefs, one that assumed their discourse-independent existence without specifying where and how one could get hold of them" (p. 15) Given the critiques of beliefs as insufficient and decontextualized, some researchers turned to identity studies. As Rodgers and Scott (2008) noted, "identity

and identity formation have taken center stage, subsuming the categories of belief, attitude, life history, and personal narrative" (p. 732).

What is Teacher Identity?

Over the past few decades, teacher identity has emerged as a separate field of study within education. The empirical shifts from behavior to thinking to knowledge and beliefs provided the groundwork for this multifaceted and ecological domain. Many scholars use identity to understand teacher knowledge and development (Beijaard, Meijer, & Verloop, 2004). Identity has been explored from multiple interdisciplinary and epistemological perspectives (e.g. cognitive, narrative, poststructuralist, etc.). In this dissertation, I focus on sociocultural perspectives on teacher identity.

Sociocultural perspectives attend to the socially constructed and culturally figured aspects of identity though language and interactions in educational contexts. Building from diverse fields of study such as social psychology, sociology, philosophy, sociolinguistics, and anthropology, I engage with teacher identity as both a unit of analysis and a heuristic to open up understanding. I consider teacher identity as both the process through which one develops as a teacher and the product, both *how* and *what* or *who.*

One of the values of this line of research is the attention to tensions experienced between an individual's highly personal conceptions of teaching and those conveyed by the teacher preparation programs and schools in which they learn to teach. Across studies, teacher identity was viewed as multifaceted and an ongoing

process of integrating the personal with the professional. However, a central limitation across research studies was the way that certain kinds of professional knowledge or competencies were often bracketed out, forcing a focus on singular course offerings, or experiences, to make sense of the complex process of becoming a teacher. This is consistent with Wideen, Mayer-Smith, and Moon's (1998) critique of research on teacher education as focused on confined aspects of teacher education (e.g., a specific methods course) over short periods of time (such as one semester) that tends to ignore the web of contexts and relationships within the learning-to-teach ecosystem.

Despite the growing interest in teacher identity and identity formation, relatively little research has focused on the specific contribution of preservice preparation and experiences (or lack thereof) to novice teachers' identity. Book and colleagues (1983) surveyed 473 undergraduate teacher candidates regarding their expectations of their undergraduate teacher education program. They found that most students entered the program already confident in their ability to teach, and few students believed they had much to learn from formal teacher preparation. The authors assert: "Regardless of the reason, it is disturbing that preservice teachers by and large do not perceive a strong need to obtain a knowledge base in pedagogy in order to become effective teachers." (pp. 10-11). More recently, Olsen (2008) conducted case studies of eight prospective English teachers in four different graduate-level preparation programs, finding that professional identity emerged from the interaction of personal orientations and program context. Personal perspectives

and predilections played a prominent role in determining what students took away from their respective programs. In some instances, prospective teachers actively rejected the perspectives and practices espoused by their programs.

Horn and colleagues (2008) drew upon the concept of "figured worlds" (Holland et al., 1998) to conduct a longitudinal ethnographic study of learning and identity formation as experienced by novice teachers of mathematics and social studies. In their analysis, they highlight processes of identification and negotiation as the 8 intern teachers navigated the two worlds of university coursework and field experience. Throughout Horn and colleagues find that these processes both shape and are shaped by the learning that the interns experience, with important implications for the design of teacher education venues.

Teacher identities are continually made and re-made through complex, situated learning processes. The role of language is critical. Prospective and practicing teachers are simultaneously positioned by particular ways of conceiving of and enacting themselves as teachers and agentive as they author their teacher identity. This perspective mirrors sociolinguist Norman Fairclough's (2001) notion that we are *enabled through constraints* – simultaneously positioned and limited but also agentive. As an analytical lens, teacher identity is a way to discern teachers' codevelopment in, through, and by situations as they respond to multiple, often competing, perspectives on teachers and teaching. The assumption here is that who one is or becomes as a teacher is neither a solely individual nor social phenomenon.

Although there is not one coherent or agreed upon definition of identity in general, or teacher identity more specifically, there are some overlapping dimensions that figure dominantly in the literature on teacher identity. The dimensions that Rodgers and Scott (2008) noted in their chapter on the development of self and professional identity when learning to teach, clearly articulate some of the shared perspectives in contemporary views of identity and cohere with sociocultural renderings of identity. Below, I introduce and explain each one.

Identity is formed within and across contexts.

Who one is, or becomes as a teacher, develops through the various educational contexts in which they participate. Rodgers and Scott (2008) highlighted the influence of macrostructures such as social, cultural, and political forces that shape local contexts and people in them. Teachers are not merely products of a certain teacher preparation program or their school context but also develop in tandem with the larger social history of schools, students, teachers, etc. They argued that,

> [c]ontexts inevitably shape our notions of who we perceive ourselves to be and how others perceive us. We do not necessarily perceive contexts (which include ways of thinking and knowing) as much as we absorb them, often taking for granted what is 'real' (p. 734).

These contexts set up norms that are realized, revised, and even resisted. A person's experience of – and development within these educational contexts – is affected by their own social positioning by race, class, gender, etc. These macrostructural categories have real consequences for how one understands and enacts themselves in contexts – and how they are perceived by others.

Nolan (2006), in her research on secondary preservice math teachers, described the influence of a reform-oriented math curriculum course for preservice math teachers on the student teachers' "mathematics pedagogical identity" (p. 242). She found that the student teachers drew on other dimensions of their identity (past experiences, conceptions of teachers' work, and attempts to engage with the methods being taught) to often resist the revised pedagogical approaches. In this dissertation, context figures heavily in how the candidates chose teaching, came to understand themselves as particular kinds of teachers, and made career plans.

Identity is formed through relationships with others and involves emotions.

Within and across educational contexts, teachers form relationships with others. These relationships bring out different aspects of who they are as teachers – confirming that they are (and are not) particular kinds of teachers. Emotions are an important part of these relations and the identities produced through them. Hargreaves' (2001) conception of 'emotional geographies' is useful; these are "the spatial and experiential patterns of closeness and/or distance in human interactions and relationships that help create, configure, and color the feelings and emotions we experience about ourselves, our world and each other" (p. 1061).

So, these relationships shape understandings of who we are which are guided, in part, by how we feel about ourselves and others. For example, what is the distance between how a teacher feels and how they are expected to feel? How does this shape who they are as a teacher and their commitment to the profession? How can we attend to both the relational dimensions of teaching and learning to teach and the emotional

labor of teaching and the emotional discourses in schools about teachers and teaching. Consider, as an example, Sue from Achinstein and Ogawa's (2006) article about two teachers who resisted their scripted literacy programs. While Sue articulated pedagogically sound reasons to deviate from the expected curriculum, she also described an unexpected sense of isolation and lack of support. According to her induction mentor, this isolation built a kind of disenchantment with her work as a teacher and lent legitimacy to her efforts to, more or less, silo her professional practice at the school.

Also, Volkmann and Anderson (1997) focused on a first-year chemistry teacher's journals to understand the process she engaged in to develop her professional identity. Using a hermeneutic phenomenological approach, attending specifically to metaphors, they called attention to the tensions she experienced between personal and professional identities across the variety of professional identities that she could adopt (e.g. the 'best teacher' or 'caring teacher'). They found that,

> her desire to be the best teacher was thwarted by her lack of understanding of chemistry and by her belief that she did not think scientifically. This led Maria to identifying herself to herself as a favorite teacher, rather than the best teacher — a visualization that enabled her to privately acknowledge her dislike for chemistry but did not address her wish to be the best (p. 307).

They proposed that a teacher's identity exists at the nexus of pedagogical knowledge, content knowledge, and pedagogical content knowledge which all come into contact with the kind of teacher one wants to become.

Walshaw (2004), in her study on preservice math teacher identities, addressed Foucault's notion of governmentality of individuals "in which processes of identification are explored as they are lived by individuals in relation to both structural processes and lived experiences" (p. 67). Drawing on his work, she shifted to the notion of 'subjectivities' over identities to attend clearly to the individual as being produced by the interplay by structure and experience. She found that, for many of the preservice teachers that were the focus of her study, "this new space [the transition from university courses to student teaching] was fraught with ambiguous and sometimes painful negotiations to produce individual subjectivity" (p. 78). Such tensions in learning to teach are produced, in part, because of the power differential between the student teacher and master teacher. So, the negotiations between these happen not just in technical, curricular terms but also along the lines of emotional experience and identity development. In chapter five, I explore how one candidate's complicated relationship with her cooperating teacher reified the very kind of pedagogical and classroom management approaches she described disliking. Seeing the CT as a kind of gatekeeper to future employment, she chose to model her teaching despite strong inclinations to not.

Identity is 'shifting, unstable, and multiple'

Although it appears generally accepted among sociocultural perspectives on identity that there appears to be some consistency to one's identity (a core identity, or what Mead referred to as "I" which I will take up later in this chapter) – it is also agreed that one's identity is not static, as identities change over contexts, situations,

and time. In the review of literature on teacher identity, Beijaard, Meijer, and Verloop (2004) noted that,

> [i]dentity development occurs in an intersubjective field and can be best characterized as an ongoing process, a process of interpreting oneself as a certain kind of a person and being recognized as such in a given context…. identity can also be seen as an answer to the recurrent question: "Who am I at this moment?" (p. 108).

Following Holland, Lachicotte, Skinner, and Cain (1998), persons are composites of multiple, contradictory identities. They argued that '[o]ne has to develop a concept of oneself in the activity and want to realize that self or avoid it" (p. 150). Beijaard et al (2004) located the activity of learning to teach with the teacher who they argued chooses from available resources to pursue goals. Having a range of available subjectivities, teachers are also agential in their development. Teachers are neither unfettered in their identity development nor completely restrained. However, as Rodgers and Scott (2008) noted, although the literature suggests and sometimes implores teachers to resist the normative forces and *author themselves* -- how to author is generally not addressed. They asked, "If one's identities are to be 'self-authored' then who is the 'self' doing the authoring?" (p. 737). Holland et al's (1998) example of Gyanumaya, from their fieldwork in Nepal, is helpful here. A dilemma occurred when she, a lower caste woman was invited to interview in the house where the researcher lived, which was considered to be on the level of a higher caste. The caste difference dictated that she could not enter by the front door. So, to enter the house, she scaled the outside wall to the balcony where the interview would take place. Holland, et al interpreted her mode of entry as an icon of limitation – the clear

cultural restraints of caste imposed on her. Her response was a meaningful improvisation. As an improvisation, it was not an end point but served as a point of inquiry for what would happen next. Such improvisations illuminate intersubjective development as people draw on different subjectivities and possibilities to operate among constraints. Note Pierce's improvisation in chapter five as he was faced with challenging student behaviors but attempted to address them differently than what was modeled by his CT.

Identity is constructed and reconstructed over time through stories, highlighting the integral role of language, specifically narratives.

As Watson (2006) noted, in an article about teachers' practice narratives and identity development, "telling stories… is doing 'identity work'" (p. 525). This perspective on identity development is often attributed to Clandinin and Connelly (1986, 1995, 1999, 2000) who conceived of one's teacher identity as an embodiment of their stories shaped by the 'landscapes' in which they live and work. Similarly, Sfard and Prusak (2005) equated these narratives with one's identities. Through language, specifically narrative, one's teacher identity is constructed through the stories that they and others tell. Consider Tanya's desire shift from conceiving herself as a teacher focused on social justice and reparation to being a fun and well-liked teacher and how that narrative focused her teaching and was also a lens she used to analyze students in ways the essentialized their identities.

These stories change over time and contexts. An example of a narrativized identity would be the transition from being a novice to full-fledged members of

Alcoholics Anonymous in which the participants learn the AA discourse and integrate it (or not) into their own story. Holland et al (1998) argued that "they learn to tell about themselves and their lives in this way, and the process of learning can take much effort and cooperation between the neophyte and other AA members" (p. 84). It is through the situated telling and re-telling of these stories that identities are shaped. This is not only an important epistemological perspective – that our identities are storied – but also an empirical one as it privileges narrative representations, and language in general, as an important way to explore and understand teachers' (developing) identities. For the inquiry for this dissertation, as I will describe in more detail, I privileged language and narrative both theoretically and analytically.

I take up these dimensions in this chapter as I present research on teacher identity and the sociocultural framework that I used to conceptualize my research. In the next section, I discuss the value of teacher identity for a study on recruitment, preparation, and early career choices – and my reasons for selecting teacher identity as a theoretical and analytical framework for this research.

Math Teacher Identity: A Developing Area of Study

In math education, a growing body of literature uses an identity framework to explore student learning (Anderson, 2007; Boaler, 2002; Boaler and Greeno, 2000; Darragh, 2016; Langer-Osuna, 2015; Rubin, 2007). However, the literature on *math teacher identity* is sparse. Studies of math teachers from these empirical and analytic perspectives are beginning to account for the complex, situated, and ever-changing dimensions of teachers that marks the larger teacher identity literature. However,

many representations of math teacher identity have focused on singular subject-only dimensions of their own teacher identity, such as a "mathematical identity" (c.f. Grootenboer and Zevenbergen, 2008). Within the literature on math teacher identity, there is a heavy emphasis on identity as a learning process (deFreitas, 2008; Goos, 2005; Lerman; 2005; Nichol & Crespo, 2003) mostly from an additive perspective (e.g. what is added to one's self as a teacher through participation in various educational contexts).

Studies in this area tended to focus on the relationship between discrete events, courses, or interventions within teacher preparation programs and/or professional development projects and teacher identity development. Here, researchers highlighted the relationship between personal knowledge (often derived through biographical accounts or journals) and professional knowledge, sometimes with limited attention to contextual factors. Some studies focus on individual courses or experiences.

Why Teacher Identity?

My own interest in teacher identity came initially from my search for ways that teacher education and other professional learning could encourage teachers to develop and enact their professional agency. Having taught in urban, highly constrained[3] environments, I found connections to certain resources, people, and communities allowed me a certain ease in navigating these contexts. This included

[3] For example, scripted curricula were adopted for both literacy and math in the schools where I taught.

new teacher allies and progressive mentors, as well as contact with Education professors as I stayed enrolled in courses at local colleges. I found that because of these unique contexts and resources I was able to do much more than merely read the script and monitor my students for narrowly defined improvement, which were the pedagogical modes of the schools in the urban sites where I taught.

I became very interested in those teachers who endeavored to teach in ways that questioned or even disrupted what I saw as limited and limiting modes of instruction and texts. As a graduate student, I looked for ways to explore teacher development, specifically in teacher preparation programs that prepare teachers for 'high-need' contexts, that valued multiple ways of understanding teachers, their goals, and development. I sought to understand how teacher education could be leveraged for positive change in the profession. From earlier work on teaching and research projects, I conceived of teaching dynamically as personal, political, social, intellectual, and technical work and wanted to do research that would allow me to address this multidimensionality. I considered attempts to understand and explain teachers and teaching that did not attend to context (micro-, meso-, and macrostructures) as incomplete and did not want to adopt an approach that would sacrifice complex, postmodern analyses for linear or causal answers. So, I needed a theoretical and analytical framework that could address the complexity of teachers and teaching as situated and constrained by context yet also agential.

Teacher identity, as both theoretical and analytical lens, allows me to explore teacher knowledge and development with attention to both the individual and the

context. This perspective recognizes that teachers codevelop along with and through the culture, social histories, and educational contexts in which they participated. The perspective of codevelopment highlights how individuals develop within and across multiple contexts through the various available subjectivities. As Holland et al (1998) explained,

> [b]y continual rehearsal they are transfigured within the inner speech into the vocal images, the virtual voices that are the resources of pro(to)action. The interplay of a person's identities is thus open to and dependent upon a field of continuing discourse and everyday interaction (p. 251).

Who people, specifically teachers, are and become is a product of their own human agency as well as often compelling cultures, social histories, processes, and structures. Teachers are both a product of their own history and yet influenced by the educational contexts through which they are trained and teach. Attending to their co-development through overlapping (and oftentimes competing) contexts illuminates how teachers are neither unfettered nor completely constrained in their development. Teacher identity as an analytical lens privileges a kind of holism --- that allows us to see teachers as whole people embedded across contexts, not merely as deliverers of instruction. Teacher identity, taken up as a situated lens on teacher development, also points to the situation itself.

Some have addressed situation as the immediate site of interaction (e.g. Goffman, 1959). Building from Clarke's (2005) work on situational analysis, however, the notion of a situation is much broader and includes micro-, meso-, and macro-formations. She argued that "a situation is always greater than the sum of its parts because it includes their relationality in a particular temporal and spatial

moment" (p. 23). Focusing on the situations where individuals, contexts, and discourses meet are of significant interest for qualitative research. The focus is not so much on the sum of these parts as it is locating the relationships between them.

Theoretical Framing of Teacher Identity

Teaching is not just observable patterns or invisible scripts; the observable "norms [of teaching] are not determinative. Teachers retain sufficient agency to act in new, creative ways…teaching is both ordered and responsive to norms and standards and also improvisational and responsive to other participants" (Florio-Ruane, 2002, pp. 209-210). To understand the interaction between these parts – teacher as an individual working within layers of constraint – a heuristic is needed to locate the parts and connect to inquiry that will deepen understanding of teaching as both "ordered" and "improvisational." I conceive of teacher identity as that needed heuristic for teacher development.

Teacher identity opens up for analysis those aspects that are so often sealed off in research. I take a sociocultural perspective on identity in this dissertation to highlight how individual teachers draw upon different arrays of social positioning, experiences, resources, and improvisations to guide their development and enact a professional identity (or identities) in particular ways. This perspective illuminates teachers as agentive rather than passive – subjects, as well as objects – who move from one subjectivity to another and choose among these, while they maintain the capacity to imagine *and* direct themselves towards new ones. Here I offer the salient aspects of my theoretical framework: *self*; *roles and subject positions*; and *language*

and narratives. Taken together, these aspects support the articulation of an interconnected study perspective on teacher identity as an analytical lens but also an *intersubjective process of building and rebuilding teacher identities*.

Self

Discerning *the self* is fundamental to any theory of identity. In their review of the literature on teachers' professional identity, education researchers Beijaard, Meijer, and Verloop (2004) found that "the concept of 'self', often combined with other concepts, appear[ed] to be essential" in the literature (p. 113). To understand *self,* I use the definition offered by Rodgers and Scott (2008) in their empirical work on developing the self and professional identity when learning to teach. The self is "*an evolving yet coherent being that consciously and unconsciously constructs and is constructed, reconstructs and is reconstructed, in interaction with the cultural contexts, institutions, and people with which the self lives*" (p. 739 italics in original). They argued that while there is continuity and coherence to the self, it is actually the "discontinuities, shifts, and crises that signal an evolving self" (p. 738). So, while the continuities in one's identity are important, I will specifically attend to the disjuncture as sites where change may occur. This dialectic between change and constancy are at the core of identity studies – and many teacher education programs with what Feiman-Nemser (2012) refers to as a 'personal' or 'critical/social' conceptual orientation (p. 75).

Mead (1964/1932) described the self as not fixed, but arising and changing through social interaction. He wrote about the self as both 'I' and 'me.' "The 'I' is the

response of the organism to the attitudes of others; the 'me' is the organized set of attitudes of others which one … assumes" (p. 175). As Dodds, Lawrence, and Valsiner (1997), psychologists, pointed out in their analysis of Mead's work,

> I as Subject creates meaning in social interaction, but I cannot be conscious of that meaning in the instant when the action is actually occurring … in memory there is both an observed I and an observing 'me,' and it contains a reorganized … self that is made whole by a process whereby the Subject I has *become* an object of observation, 'me' (pp. 490-491).

The subject I is agentive, selecting from a multitude of responses for any given interaction; the object 'me' is reflective, relying on these experiences to plan new ones. This I-to-'me' process is not a dualism, with separated parts, but a conversation embedded in social interactions. The self is an ongoing process and project, deeply intersubjective and interactional, in which the individual retains the capacity to respond in new ways. Nias (1989) in her research on primary teachers' professional identity referred to the 'I' as the 'substantial self' or subject and 'me' and the 'situational self' or object. It is the latter, the 'me' that signals what we refer to as an identity.

Mead (1964/1932) offered gesture as the link between an individual's consciousness and their environment. Gesture, which includes language, is a stimulus that calls for a personal reaction. They are "interrupted acts that [call] forth responses from another person, and 'attitudes' as habituated connection between environmental stimulation and personal response" (Dodds, et al, 1997, pp. 488-89). It is through

gesture – as stimulus and response – that 'I' as subject becomes the observable 'me' as object to oneself. For meaning to arise through interaction the individual must internalize the environment, including the 'Generalized Other' (elaborated in next section). Mead (1925, cited in Dodds, et al., 1997, p. 492) provided the example of shopping; the initial activity, 'buying', occurs because there is an understanding of what 'selling' is. This is a gesture-response sequence that occurs only because there is a generalized understanding of the environment (e.g. store) and the roles that people take on in that setting (e.g. buyer, seller).

It is the individual's ability for reflection or, what Holland, et al (1998) termed 'self-objectification' which allows for "self-direction [and] plays into both their domination by social relations of power and their possibilities for (partial) liberation from these forces" (p. 5). Connecting to teaching, it is this I-to-'me' process that allows for the development and/or codevelopment, of a professional identity. For example, a teacher engaged in their work selects from a range of available responses, texts, communication styles, etc., to respond to their students' needs. Once completed, this experience becomes part of the teacher's 'me', allowing them to reflect on their response and use that to inform further decisions. However, the teacher has limits to the 'me' they enact – from experiences, institutional constraints, and the demands of the given situation, including the other participants. As Bakhtin (in Holquist, 1990) discerned, the "self is like a sign in so far as it has no absolute meaning in itself; it, too, (or rather, it most of all) is relative, dependent for its existence on others" (p. 35). The self is constrained by the context and actors.

Although there can be different selves, the self that gets enacted "is dependent upon the set of social relations that is involved as to which self we are going to be" (Mead, p. 143). "The individual experiences their self as such, not directly, but only indirectly, from the particular standpoints of other individual members of the same social group, or from the generalized standpoint of the social group as a whole to which he belongs" (Mead, p. 138).

Unlike modern conceptions of the self as fixed and slowly revealed, Mead presented the self as developing in and through language and social relations. Holland, et al (1998) used the term 'codevelop' to describe this ongoing process as both the individual and the social situation interact, producing change in both (p. 33). Structures are not deterministic and the self is not predefined; both retain the ability to change. Using the metaphor of an eddy, Mead wrote, "[t]he self is not something that exists first and then enters into relationship with others, but it is … an eddy in the social current and so still part of the current" (p. 182). The self, then, is inseparable from context.

The concept of codevelopment, as noted earlier, is an important one. The teacher codevelops along with their students, the social history of schools, teachers, and teaching, educational context(s), social and political realities, etc. People and contexts both hold the potential to change through these interactions. As Mead wrote, "the effect of every adaptation is a new environment which must change with that which responds to it" (Mead, 1908, p. 312, cited in Dodds, et al, p. 487). The notion of a changing environment is necessary in this view of self as fundamentally social

and changeable. Seeing the personal and social as interdependent and codeveloping requires specific attention to the ways that teachers and teachers' work are generalized within and across the contexts of teacher education and K-12 schools – the environments in which they are trained and work. These understandings are not neutral and the teacher identity that is enacted is not arbitrary. The enacted self, though agential, is also deeply social, developing through intersubjective relationships and processes.

Roles and Subject Positions in Figured Worlds.

Important to the theory of codevelopment are the meso-level contexts, such as schools and communities, and those interactions that figure teachers and teaching in particular ways. Holland et al (1997) argued that "sentient beings always exist in a state of being 'addressed' and in the process of 'answering'" (p. 169). These roles (and, as I will explain later, subject positions) shape expectations and it is by responding to these that one's identities as a teacher develops. The subject 'I' responds to these social and cultural expectations by forming a 'me' (or multiple 'me's). Fairclough pointed out the 'felicitous ambiguity' of the term 'subject' where

> [i]n one sense of subject, one is referring to someone who is under the jurisdiction of a political authority, and hence passive and shaped: but the subject of a sentence, for instance, is usually the active one, the 'doer', the one causally implicated in action" (p. 32).

As subjects, teachers are both constrained yet remain active in their personal and professional development. In this section, I introduce these concepts: teacher role, subject positions and positioning, and figured worlds.

Teacher Role

I begin with teacher role because it is often used in research on teachers and teaching to define the practices or functions of teachers' work. As a theoretical concept, teacher role is defined and applied in a variety of ways in the education research literature. These understandings come from diverse fields such as social role theory (e.g. Turner, 2001); critical views of teachers (e.g. Apple, 2013/1986); and perspectives on teachers' work (Popkewitz, 1998; Smyth & Shacklock, 1998). Teacher role is a heuristic employed to explore a range of empirical and theoretical topics such as changes in teachers' work (Bartlett, 2004; Valli and Buese, 2007); defining and exploring teacher resistance (Bullough, Gitlin, and Margonis 1984), and locating intersections between curriculum change and teachers' work (Apple, 1989). Ronfeldt and Grossman (2008) argued that, "[a]s people observe others in the professional role, they generate a repertoire of potential identities" (p. 42).

Roles are the situationally-specific functions one performs. An important part of teacher education is for candidates to observe others in these roles and practice them for themselves. Others (e.g. Castells 1997) separate roles from identities – delineating that identities organize meaning where roles organize function. I find that these are inseparable; the functions one serves and the sense they make of that in light of personal and situated knowledge are, for the purpose of this research, different yet related aspects of the same heuristic.

Mead's concept of the 'Generalized Other' is one way to conceptualize how roles are enacted through social interactions. Role is both a shaping influence that bounds

teachers' work and can be employed as a heuristic to explore change in teachers' work as the individuals who occupy those roles transform them. In Mead's view of the Generalized Other, the perspectives, attitudes, and roles of a group are incorporated into the individual's own thinking – it is not necessarily a simple transfer (where a person assumes the roles) but, in line with a sociocultural view of identity, is one where there is room for individual mediation and improvisation. Dodds et al (1997) reviewed a wide range of Mead's works to devise a sociocultural analysis of his thinking about 'self-directed thought and self-consciousness' and found the notion of the Generalized Other to be salient.

> Taking the attitude of the Generalized Other involves neither acquisition of a static property of the social world, nor individualized constructions of social perspectives. It involves the person's assumption and interpretation of a common attitude, in a process that begins with social action and moves through personally organized adjustment to achieve a sense of self within the social (p. 485, refers to Mead, 1925).

Interactions with others in a particular social setting includes the integration of social roles and group conventions but is not complete until the individual begins to anticipate the responses of others and directs their own actions and responses in relationship to what is anticipated. The individual takes for granted that there is a common (though not necessarily simple) attitude which is the notion of the Generalized Other and then orient themselves around that attitude, allowing for a response that is both personal and social. Take, for example, the child who attends school for the first time; they build understandings of the rules for their participation and is able – over time – to predict some of their peers' and teacher's responses to themselves and others. What makes this an intersubjective activity – rather than mere

internalization and replication of social roles – is that it "relies on the generativity and authenticity of personal, interpretive thought" (Dodds, et al., p. 499). So, this development is both highly social and personal. Within this view, that child not only participates in socially constructed ways of being a student, but also calls upon the breadth of their life experiences and imaginative acts, to individually interpret, respond to, and enact these roles in nuanced, stylized ways. It is in these improvisations that identities become distinct from roles.

Bullough, Gitlin, and Margonis (1984), in their exploration of teacher resistance, regarded role as a way to define the boundaries of teachers' work. For them, role provided "a point of action for teachers and situates events in the forces of production as manifest in institutional structures, in human interaction, and, significantly, in consciousness" (p. 341). Examining role "forces attention to context variables, interests, and histories … [as roles have] histories and are formed interactively" (pp. 341-342). Similar to Mead's *Generalized Other*, but situated within the Marxist framing of forces of production, they point to the intersubjectivity of teachers' roles as bounded, but also co-produced. Bullough, et al., looked to role as a heuristic for exploring teacher resistance that, they argued, can be understood as the 'reshaping' of role. They highlighted the historical and ideological bases of teachers' role and interactive formation, which allows for resistance and, over time, the transformation of teachers' work.

> The challenge before teachers, then, is one of defining role, of reshaping it, and of building supportive institutional structures and shared understandings. Building understanding is necessary because any change in teacher role will necessarily alter administrator and student roles. As role becomes less taken- for-granted, less

> ideologically embedded, and as teachers begin to evaluate how they might create more humane and educative life spaces within schools, resistance becomes those acts that press up against role boundaries (p. 342).

One example, or perhaps a counterexample of this, would be Ahlquist's (2001) work on social justice orientations of preservice math teachers who she found were more likely than those in other subject areas to dismiss social justice issues as irrelevant to their teaching. This rejection of social justice-focused roles amongst preservice math teachers is reflective of critiques of math teachers in general (Gutierrez, 2013; Gutierrez, 2002; Gutstein, 2006) for focusing on content and traditional instructional delivery modes over a person-focused, critical approach.

Subject Positions and Positioning

Davies and Harré (1990) in their sociolinguistic analysis of positioning through discourse explored ways that subject positions focus on more dynamic aspects of social interaction and development that the more static and formal aspects of role seemed to hide. In role theory, the person is always separable from the various roles that they take up; any particular conversation is understood in terms of someone taking on a certain role. The words that are spoken are to some extent dictated by the role and are to be interpreted in these terms. With positioning, the focus is on the way in which the discursive practices constitute the speakers and hearers in certain ways and yet at the same time is a resource through which speakers and hearers can negotiate new positions (p 62).

They found that thinking in terms of positions opened analysis to include contextual and analytical approaches such as indexicality. For example, students

making sense of their gender, race, class, etc., in education contexts express this intersectionality through the positions that are available (see Carbado, Crenshaw, Mays, & Tomlinson, 2013, for a discussion of intersectionality). The subject position imbues them with a certain repertoire. Davies and Harré argued that after

> having taken up a particular position as one's own, a person inevitably sees the world from the vantage point of that position and in terms of the particular images, metaphors, story lines and concepts which are made relevant within the particular discursive practice in which they are positioned (p. 46).

The individual is not merely a mirror of these social positionings but is constituted and re-constituted through the various discursive practices in which they participate. These positions are embedded both in our self (the I) and in the specific identities (me's) that develop. The I and me's that result can be contradictory. It is these contradictions and the opportunity to choose among them that allows for agency.

Following Ahearn (2001), I define agency as "the socioculturally mediated capacity to act" (p. 130). Agency is not a synonym for free will and it does not necessarily signal resistance. Drawing on Giddens' structuration theory, which links agency to structures, structures exist only to the extent that people replicate them. Giddens argued that structures do not determine behavior, although people do tend to replicate them due to a "deep-seated need humans have for ontological security; the need to maintain a sense that the natural and social worlds are as they appear to be and that the view of self and social identities that individuals have are stable and reliable" (Shilling, 1992, p. 83). Since action occurs through individuals replicating structure (or not), change in the structures is always possible. By responding to a situation for which there is no set response, one draws upon their various subject

positions. These acts are meaningful for the next moment of action. For example, Fairclough (2001) wrote that

> [s]ocial subjects are constrained to operate within the subject positions set up in discourse types … and are in that sense passive; but it is only through being so constrained that they are made able to act as social agents … Social agents are active and creative … Discourse types are a resource for subjects, but the activity of combining them in ways that meet the ever-changing demands and contradictions of real social situations is a creative one" (p. 32).

The repetition of known modes of teaching and privileging certain kinds of learners, as is evidenced in the data for this research, is an example of the interplay of agency and structuration. Though we retain the capacity to change, we may not.

Such positioning, Davies and Harré (1990) argued can be interactive (where one person positions others or another) or reflexive where individuals position themselves through discourse. They are not only constructed by and through discourse but these identities can be parsed through the discourse analytics. By talking, speakers' words invoke images and metaphors indexing their position(s). These are not necessarily intentional and the resulting autobiography may not be clear or linear. Charlotte Linde (1993) in her work on life stories wrote that,

> the life story is a temporally discontinuous unit told over many occasions and altered to fit the specific occasions of speaking, as well as specific addressees, and to reflect changes in the speaker's long-term situation, values, understanding and (consequently) discursive practices (p. 51).

The narrative given at any moment reflects not only what is occurring but the meaning(s) the speaker attributes to it. For example, when describing their reasons for pursuing a career as a math teacher, all of the teacher candidates for this study attributed their decision, in part, to their own early (and unusual in contrast to their

perception of childhood peers) success in mathematics. In doing so, they framed success in math as not only a necessary precursor in terms of required content knowledge but often that such mastery was a kind of exclusive property and necessarily privileged math teaching as a potential career. Similarly, they each drew on examples from K-12 schooling where teaching others was one way to demonstrate subject mastery. This notion of exclusivity aligned with their personal experience of success in math as special or unusual and invoked the larger discourse about the need for (and, hence, the lack of) qualified math teachers. This not only confirmed their career choice – but also prioritized content knowledge over other important domains of teacher knowledge and skills for math teachers. Such mastery was often prioritized in their narratives over other forms of knowledge, skills, or interests related to teaching. Doing so created a kind of situationally salient coherence from childhood to career choices.

The teacher candidate takes up these positions (e.g. success in math as a kind of exclusive property) as they play with, and appropriate some of these roles en route to becoming a teacher. These enacted and/or idealized positions shape the kinds of perspectives and practices the teacher (or teacher candidate) will take on. As Holland et al noted, "one looks at the world from the angle of what one is trying to do" (p. 44). *Perspective* is both the angle through which a person views the world (through one's position in the activity) and one's take on activity from their position in it.

Perspective

Becker, Geer, Hughes, and Strauss (2007/1961) wrote that, analytically, "[p]erspectives arise when people face choice points" (p. 35). In the balance between constraint and open choice, perspectives are developed and/or enacted when the individual must respond. There are both shared perspectives, that have the feeling or force of something 'everyone' in that context knows, and those individually mediated and held. Let us consider the current case concerning math mastery. So, although each candidate in this research came from vastly different school contexts (urban, low, SES diverse; rural, high SES, and homogenous; suburban, mixed SES, diverse), they were each deemed successful in math. They regarded this as important in their choice of undergraduate major and, later, their decision to teach. Shared among the cohort members was the sense that, due to their earlier experience and the small size of the math major at Cliff University, and the even smaller subset of math students in the Teach STEM program, that this success made them part of an exclusive and at times cohesive group. That said, their interpretation of the value of math and even the kinds of math and approaches to math teaching that should be taken up in schools differed between the individuals. So, while this monolith of "math teacher" may have hailed people with similar subject experiences and orientations, the practices and perspectives they hold are subjective and improvisational.

For this dissertation, I use 'perspectives' as an important way to understand both collective and individual orientations to math teachers and teaching, in general, and to changes over time both collectively and individually. Building, in part, on the

seminal work on medical education by sociologists and symbolic interactionists Becker, Geer, Hughes, and Strauss (1976) *Boys in White: Student Culture in Medical School*, I attend to perspectives as revelatory of both the institutional cultures in which the candidates in my study participated and the ways they individually understood and mediated these. They wrote,

> [i]n many crucial situations, the individual's prior perspectives allow him no choice, dictating that he can in these circumstances do only one thing. In many other situations, the range of possible and feasible alternatives is so limited by the physical and social environment that the individual has no choice about the action he must perform. But where the individual is called on to act, and his choices are not constrained, he will begin to develop a perspective (Becker, Geer, Hughes, & Strauss, 1976, p. 35).

They identified a few aspects of perspectives that are particularly salient for this research; specifically, that depending on one's life experiences and initial perspectives, each situation may not present the same problems (or kinds of problems) to all people. So, the situations that became topics of conversation in the interviews for this research depended largely on how the participants defined what was important. They also introduced a useful distinction between immediate perspectives, short-term and situationally salient, and long-range perspectives, those long held that the person brings to bear on the current situation. As I will discuss later, this is an analytically useful and sometimes perplexing approach. Since there is really no starting point for choosing one's career other than those we might retrospectively apply to our life stories, discerning between immediate and long-range perspectives becomes a process of separating out those perspectives represented over longer periods of time (and at times represented as long-held perspectives) in contrast

to those that appeared to emerge in situations. So, while I use these distinctions, I want to acknowledge that immediate perspectives may have aspects of long-range perspectives embedded in them and vice versa. For example, in chapter five where I discuss Carmen's overarching focus on different forms of student control, the situationally immediate responses and seemingly short term perspectives have embedded in them the candidates' long socio-histories including perspectives on schooling and control. So, in some ways, they are inseparable. However, it is analytically useful when addressing choice points and change to look at how long held perspectives arise in immediate situations.

Codevelopment through Language

As noted throughout this chapter, language is central to sociocultural perspectives on identity, in general, and to the theoretical and analytical frameworks for this dissertation, specifically. Following Ahearn's (2001) work on language and agency, I define language "as a form of social action, a cultural resource, and a set of sociocultural practices…. whether spoken or written [language is] inextricably embedded in networks of sociocultural relations" (p. 110). In this chapter, I build on the assumption that "language constructs and locates individuals and groups in certain ways" which means that I privilege texts and discourse as means for understanding teacher identity (Smyth & Shacklock, 1998, pp. 246-47).

Central to this assumption is the *linguistic relativity* hypothesis. Linguistic relativity, posited by anthropologists Sapir and Whorf (1956), is the "hypothesis that

language both expresses and creates categories of thought that are shared by members of a social group" (Kramsch, p. 235). Whorf wrote,

> We cut nature up, organize it into concepts, and ascribe significances as we do, largely because we are parties to an agreement to organize it that way – an agreement that holds throughout our speech community and is codified in the patterns of our language … We cannot talk at all except by subscribing to the organization and classification of data which the agreement decrees … From this fact proceeds what I have called the 'linguistic relativity principle,' which means, in informal terms, that users of markedly different grammars are pointed by their grammars toward different types of observations and different evaluations of externally similar acts of observation, and hence are not equivalent as observers, but must arrive at somewhat different views of the world. (1956, pp. 212-213, 221).

That meaning and culture are constructed by, and negotiated through, language allows us to see not only how we are constrained by language but also how we might draw upon language from fdiverse sources to imagine and reconstitute new goals for our personal and professional lives. Linguistic relativity also attends to variation in understanding. While the original theorem addressed differences between speakers of different languages, it is also understood as distinguishing variation in understanding among participants in different discourse communities who speak the same language. From this perspective, speakers have a particular set of experiences via discourse, which position them to interpret words differently, ascribing both generally- and individually-held meanings. So, for example, for the term 'math teacher,' one's life experiences interact with the generic definition – e.g. one who teaches math -- to produce their understanding. Language is central to the interactional processes where meanings are co-constructed and mediated.

Kramsch, a linguist whose research interests include intersections of language, culture, and identity, links texts (inclusive of discourse) and signs, connecting linguistic relativity to *semiotic relativity*. "[L]anguage transforms thought and 'provides the essential ground for the development of human consciousness'" (Kramsch, p. 242, citing Lucy & Wertsch, p. 83). She located the source of this transformation as being in not only words, but also signs.

> It is Vygotsky's semiotic theory that gives a clue as to how this transformation might take place. Words are both tools and signs. However… unlike tools that refer to and act on objects, signs do not refer only to objects, but point to a multitude of other signs that are all potential candidates for selection and combination in the creation of meaning. The ability to select among all the possible signs provided by the speech community those that are the most relevant to the speaker or listener, and to combine them with other signs, is the hallmark of individual freedom and creativity (pp. 242-43).

This connection is an important one as semiotic systems mediate "both psychological and social processes, because symbols can only be recognized and interpreted if they are shared by a community of sign users who agree on their meaning, even if sign users differ in the associations and combinations they make of these signs" (Kramsch, 2004, p. 242). Kramsch, focusing on the intrinsically intersubjective nature of meaning making, described this integration of linguistic and semiotic relativity as shifting "the focus away from static concepts like language, thought, and culture toward more dynamic notions of speakers/writers, thinkers, and members of discourse communities" (p. 255).

The individual is both engaged actor and attuned to the words spoken. Dodds, et al (1997) refer to Mead's writing on how meaning is made,

> Through hearing speech in the same way as another hears it, the person became an object and was able to build the 'me' of the social interaction … All social gestures functioned in the same way, but language as the most elaborated and complex of gestures facilitated the complex interactions necessary for the development of meaning and the consciousness of meaning (pp. 489-490).

From these perspectives, speakers have a particular set of experiences via discourse, which position them to interpret language differently, ascribing both generally- and individually-held meanings. Language is central to the interactional processes where meanings are co-constructed and mediated; also important, however, are the signs (e.g. pictures, symbols, gestures, etc.,) that – as either tool to mediate or part of the communication itself – are part of the interactions. For example, Pierce's focus on sociocultural theories and approaches to teaching and learning gave him a new language to reflect on his own student experiences and imagine ways of teaching that he largely had not experienced.

Study Perspective: Humanistic and Intersubjective

The study perspective for this research is humanistic, intersubjective, and focused on language. McCall and Wittner (1990) in their chapter on Symbolic Interactionism and life history research, outline four criteria that constitute *'humanistic'* research and analysis. To qualify, they suggest that

> [i]t must attend to (1) *human subjectivity and creativity* – showing how individual respond to social constraints and actively assemble social worlds; (2) it must deal with concrete human experiences – talk, feelings, action – through their *social, and especially economic, organization* (and not just their inner, psychic, or biological structuring); (3) it must show a naturalistic *"intimate familiarity"* with such experiences – abstractions untampered by close involvement are ruled out; and (4) there must be a self-awareness by the [researcher] of the ultimate *moral and political role* in moving towards a

> social structure in which there is less exploitation, oppression, and injustice, and more creativity, diversity, and equality (p. 52, italics in original, numbers added for clarity).

Intersubjectivity originated in the work of American Pragmatists such as Mead, who located identity in daily life, produced through interaction. Mead's notion of intersubjectivity suggests that human capacity to develop in multifaceted ways (emotionally, socially, intellectually) is relative to how much they take part in symbolically mediated interactions with other persons. Such ontogenetic development, as Mead described was irreducibly intersubjective. He explained that social norms, shared meanings, and systems of morality arise from and are made real from reciprocal perspective-taking required for symbolic interaction. Intersubjectivity understood as reflexive and linguistically mediated, allows us to locate interactions and intersections between mind, self, and society.

Applied to the teacher candidate, this active view of the individual focuses on both the intersubjective and agential processes of becoming a teacher. The teacher candidate makes sense of a range of discourses, texts, and symbols simultaneously shared and individually mediated. They are shaped by the demands of the setting and people involved and simultaneously shape the context(s) and themselves as teacher. Understanding this process as active, rather than passive, directs attention to the creative and agential processes involved in developing oneself as a teacher. What an individual brings to the study and practice of teaching *(the 'I')* and the ways that teachers and teachers' work are represented, experienced, and practiced through educational contexts (*subject positions*) which are themselves embedded within

social-cultural-historical understandings of teachers and teachers' work, are fundamental to the process of developing one's teacher identity (*the multiple me's*).

As sociolinguists Bucholtz and Hall (2004) pointed out in their article on linguistic approaches to understanding identity through interaction, it is "crucial to attend closely to speakers' own understandings of their identities … [w]hen individuals decide to organize themselves into a group, they are not driven by some pre-existing and recognizable similarity but by agency and power" (p. 371). So, when teachers take on certain professional identities it is not a benign or random process of amalgamating different parts or subjectivities. For example, all of the candidates focus largely on their field experiences to makes sense of who they are as teachers. This is not a random choice but one mitigated in part by the gatekeeping function the CT's appear to serve. As a potential link or barrier to future employment, their feedback was attended to almost exclusively. However, what this looked like in context and how each candidate took this up (or did not) was quite different.

So, although this view of the individual is agentive, it does not ignore the power and ever-present constraints. As articulated by Bakhtin (in Holquist, 1990),

> I cannot choose to model my self as, let us say, a Martian might see me if I have not had experience of Martians. I may, of course, *imagine* what Martians might be like, and then seek to appropriate their image of me as my own. But even an imaginary Martian will be made up of details provided from previous experience, for in existence that is shared, there can be nothing absolute, including nothing absolutely new" (p. 29).

Subjectivity refers to "human lived experience and the physical, political, and historical context of that experience" and provides opportunities for a self-directed existence, overshadowed by the control of social situations (Mansfield, 2000).

Subjectivities are important to the idea of codevelopment – "the linked development of people, cultural forms, and social positions in particular historical worlds" (Holland et al., 1998, p. 33). Holland et al cited Hall's (1996, p. 6) work on how subjects are 'sutured' to particular subjectivities which

> requires not only that the subject is 'hailed' but that the subject invests in the position, means that suturing has to be thought of as an *articulation*, rather than a one-sided process, and that in turn places *identification*, if not identities, firmly on the theoretical agenda" (p. 33).

So, the subjectivities that came to have meaning in the candidates' identity development were not merely hoisted on them but are identities that they came to identify with. They have some kind of salience for who they are and want to be(come) as teachers.

A useful metaphor to understand this intersubjective process of identification is *bricoleur*. Drawing on Levi-Strauss, Holland et al (1998) described a bricoleur as one "who builds with preexisting materials. In authoring the world, in putting words to the world that addresses her, the 'I' draws on the languages the dialect, the words of others to which she has been exposed" (Holland et al, p. 170). In her research on teachers who resisted top-down reforms, Eileen Honan (2006) found that the teachers in her study engaged in a process of bricolage, understood as taking "advantage of subject positions, discourses, theories, and practices" made available to them (p. 80). She found that the "[t]eachers who engage in this *bricolage* work did not simply 'resist' the top-down approach of many educational imperatives; instead they made 'secondary adjustments' in order to make sense of bureaucratic decisions in relation

to their own classrooms and own teaching" (p. 80). This highlights the intersubjective and agentive responses of teachers working within confined systems.

Teachers' identities are continually constructed and reconstructed. Citing Bakhtin, Holquist (1990 p. 84) wrote that

> the time of the self is always open, unfinished as opposed to the time we assume for others, which is (relative to our own) closed, finalizable. And yet, in order to be known, to be perceived as a figure that can be 'seen' as a person or thing must be put into the categories of the other, categories that reduce, finish, consummate. We see not only ourselves, but the world in finalizing categories of the other. In other words, we see the world by authoring it (p. 173).

So while we speak from the perspective of the "I" and author our identities from that space, the words come from our collective experience – "we also represent ourselves to ourselves from the vantage point (words) of others and that those representations are significant to our experience of ourselves" (Holland et al, p. 172).

Using a teacher identity theoretical and analytical framework to explore the developing perspectives of these three beginning math teachers as both personal and situated, shifting and sometimes stable, is a fundamentally humanistic and intersubjective approach to understanding the roles of recruitment, teacher preparation, induction, and school life on their career plans and development as teachers. In the next chapter, I address how I developed research and analytical methods that aligned with methodologies that were also humanistic and intersubjective.

Chapter Three: Research Methods and Methodology

> *Methods are mere instruments designed to identify and analyze the obdurate character of the empirical world, and as such their value exists on in their suitability in enabling this task to be done (Blumer, 1969, p. 27).*

Overview and Rationale

My dissertation focuses on three mathematics teacher candidates from one California teacher recruitment and preparation program to explore the central research question: *how do beginning math teachers develop a professional identity?* I chose identity as an analytical heuristic to attend to the simultaneously holistic and situated dimensions of teacher development. The focus is on inter-relationships between *who they are* as individuals and the *ways they were shaped by and also shaped* those contexts in which they participated. One of the important strengths of this analytical framework is the capacity to explore, rather than reduce, complexity (c.f. Clarke and Keller, 2014). Teacher identity, as a heuristic for development, challenges the often-narrow understandings of entry, development, and career plans for beginning math teachers.

Study Design

In line with my focus on identity as holistic and situated, I chose to conduct a longitudinal, qualitative study to focus on the professional identity development of this group of te**a**cher candidates in a master's/credential program. In this chapter, I introduce the research sites, the participants, and delineate features of the data collection and analysis.

The research sites for my study included the dual (and sometimes contradictory) contexts of teacher preparation -- the university setting and the local schools where the candidates completed their field experiences – and also those schools where they were later employed. Through their funding and teacher preparation program, specifically, there was an explicit focus on teaching math to students in "high-need" settings. All of the teacher candidates received the competitive STEM Scholars Fellowship, which required two years of service in a high-need district in exchange for one year of funding to complete their math credential and education Master's degree.

Qualitative data collection occurred over six years, from the start of the candidates' teacher preparation program (2009-10) through the end of their fifth year of teaching (2014-15). However, data on the candidates' place of employment (or job transition) was collected for an additional two years (2015-16 and 2016-17). The methodologies I employed, rooted in postmodern approaches to pragmatism, symbolic interactionism, and grounded theory, emphasized an inductive approach to data collection and analysis. Data collected included an initial open-ended survey; interviews with the teacher candidates; observations of the teacher candidates during the first year of the study both in university courses and their student teaching; and document collection (from the university, the schools where they did their field experiences, and those produced by the students themselves), and follow up surveys focused on employment and/or transition status. For the initial open-ended survey and interviews, questions posed focused on the students' life histories, pre-professional

experiences (including recruitment and their reasons for selecting teaching), experiences in the preparation program, understandings of math teachers and their work in general and more specifically about themselves as teachers, and their short- and long-term career plans. For data analysis, I undertook iterative phases of content analysis, open coding, analytic and comparative memos, and cross-case analysis (Bogden & Biklen, 1998; Charmaz, 2003; Charmaz, 2014; Clarke, 2005).

Research Setting and Participants.

The initial research sites for my study were the master's/credential program (MA/C herein) at Cliff University and the middle and high school sites where the teacher candidates completed their student teaching. I collected data on eight of the ten math teacher candidates in the program and focus my dissertation on three of these – Pierce, Tanya, and Carmen. As math undergraduates, these teacher candidates all took part in Teach STEM – a recruitment and early exposure program for potential math and science teachers, housed at the same university as the MA/C program, although housed in different academic divisions. Through participation in Teach STEM, the teacher candidates had early access to observing and teaching in local math classrooms, received support to apply to the MA/C program, were eligible for, and all three focal candidates received STEM Scholars fellowships.

In Chapter Four, I more thoroughly introduce the sites (both physical and discursive) that comprised the entry and preparation of the candidates. In that chapter I will to explore how the programs which had similar goals represented perspectives on math teachers and teaching – and approaches to teacher preparation – that were

both complementary and contradictory. This analysis focuses primarily on the role of field experiences and financial incentives and the theory and practice divide made real through these contradictions.

Participants: Teacher candidates (2009-2010 Academic Year).

There were ten teacher candidates in the mathematics cohort during the 2009-10 academic year. Of the ten candidates: six identified as male and four as female; eight earned undergraduate degrees in mathematics, nine received their undergraduate degree from Cliff University and, of those nine, eight participated in Teach STEM. Seven of the ten candidates received external funding to complete the MA/C program, six of these received the STEM Scholars Teacher scholarship and the remaining candidate received a local fellowship.

To elicit participation in this study, I attended the MA/C program's orientation to introduce myself and this research. I introduced the project, discussed how candidates might benefit via conversation and reflection, and gave them an opportunity to 'opt out' of selection. Two students opted out (one was funded, the other was not). After that meeting, I emailed the initial survey to the eight participants (see Appendix A) and received responses back from everyone within three days. Over the course of the first year, two people dropped out of the study. Of the six that were left, five were STEM Scholars. I chose initially to focus on these five because of their unique recruitment and early exposure experience over time and reduced this number to three candidates – Pierce, Tanya, and Carmen. Together they exemplify three very

different perspectives on math teaching – as well as hopes and trajectories for themselves as math teachers.

I describe each of the focal candidates in detail in chapters five, six, and seven. Below, find Tables 1 and 2 which provide brief summaries of the candidates and their career trajectories. In Table 1 there is a summary of their demographic information (age, race, gender) and information specific to math teaching (major, minor, participation in Teach STEM, number of placements prior to starting the math credential and whether they did other kinds of math teaching outside of Teach Stem). This is followed by Table 2 which presents data on whether and where the candidates taught for the seven years following completing their credential. Note that each of the candidates taught for a minimum of seven years and completed the required two years teaching in a high need school. Two of the focal students, Carmen and Pierce, taught exclusively in schools deemed high needed (and still do).

Table 1: Introducing the Teacher candidates

Name	**Age**	**Race/ Ethnicity***	**Gender**	**Math major**	**STEM Education Minor**	**TS participant**	**# of TS placements**	**Other math teaching**
Carmen	22	Latina	F	Y	Y	Y	3	Y
Pierce	22	White	M	Y	Y	Y	3	N
Tanya	21	White	F	Y	N	Y	2	Y

Table 2: Teaching Sites

	10-11	**11-12**	**12-13**	**13-14**	**14-15**	**15-16**	**16-17**
Cecilia	HNMS	HNMS	HNHS	HNHS	HNHS	HNHS	HNHS
Derry	HNMS	HNMS	HNMS	HNMS	HNMS	HNMS	HNMS
Maya	HNHS	HNHS	Out of state	Out of state	Out of country	X	X

Key: HNMS=High need middle school; HNHS=High need high school; HS=high school (not high need); X = did not teach this year.

Methodology

The study perspective on identity builds on understandings of intersubjectivity through language and signs. As discussed in Chapter two, I take a sociocultural perspective on identity in this dissertation to highlight how individual teachers draw upon different arrays of social positioning, experiences, resources, and improvisations to guide their development and enact a professional identity (or identities) in particular ways. Drawing on the salient aspects of my theoretical framework – *self*, *roles and subject positions*, and *language and narratives* – I offer an interconnected study perspective on teacher identity that is humanistic, intersubjective, and focused on language.

Complexity of Teacher Development

Anthropologists Law and Mol (2002) in their work exploring the relationship between simplicity and complexity in the social sciences and humanities asked, "How might complexities be handled in knowledge practices nonreductively, but without at the same time generating ever more complexities until we submerge in chaos" (p. 1)? The challenge here is to embrace complexity without falling into the domain of radical relativism. My response to this empirical conundrum was to pursue postmodern approaches to symbolic interactionism and grounded theory (Lather, 2001; Clarke, 2005).

According to Landstrom (2000), in his writing on complexity, postmodernism involves us in "the ontological politics of staying true to complexity" (p. 475). Sociologist Robert Prus (1996), in his book on ethnography and Symbolic Interaction,

argued that while there are many ways to learn about people, "to qualify as an intersubjective method, one would have to employ some variant of an ethnographic approach: an approach that opens the researcher to the life-world of the other through personal exchange" (p. 20). I focused on ethnographic qualitative methodologies and analytical approaches, which build on these theoretical and methodological domains. Doing so, I privileged individual voice while 'situating interpretation' (Clarke, 2003, p. 556).

For example, the interviews were conducted with individuals but also referred to the figured worlds of teaching recruitment, preparation, as well as the middle and high schools where the candidates taught (both as students and instructors of record). This highlights the personal, but also attends to meso- and macro- levels of recruitment and preparation, which themselves are seldomly acknowledged in views of teacher learning (c.f. Grossman and McDonald, 2008; Wideen, Mayer-Smith & Moon, 1998).

Symbolic Interaction

Historically, there have been multiple ways to look at human beings in practice. One view, coming from sociology, is Symbolic Interaction (SI herein). SI emerged from the American pragmatist school of thought. Blumer is credited with defining this area of study (1966). Drawing on Mead's work, he critiqued the positivist orientations of both psychology and sociology at the time. He wrote,

> [t]he prevailing practice of psychology and sociology is to treat social interaction as a neutral medium, as a mere forum for the operation of outside factors. Thus, psychologists are led to account for the behavior of people by

> resorting to elements of the psychological equipment of the participants – such elements as motives, feelings, attitudes, or personality organization. Sociologists do the same sort of thing by resorting to societal factors, such as cultural prescriptions, values, social roles, or structural pressures. Both miss the central point that human interaction is a positive shaping process in its own right. The participants in it have to build up their respective lines of conduct by constant interpretation of each other's ongoing lines of action (p. 538).

SI highlights the individual as active, rather than passive, and emphasizes the intersubjective nature of social life. Again, it was Blumer (1969) who outlined the three premises of SI,

> The first premise is that human beings act toward things on the basis of the meanings that have for them … The second premise is that the meaning of such things is derived from, or arises out of, the social interaction that one has with one's fellows. The third premise is that these meanings are handled in, and modified through, an interpretive process used by the person in dealing with the things he encounters (p. 2).

SI focuses on the co-construction and individual mediation of shared meanings. It draws attention "to the active dimensions (human struggles and enterprise) of the accomplishment of intersubjectivity" (Prus, 1996, p. 22). Both social and personal – the individual is an agent who interacts with self, others, and their environments to produce understandings of themselves and the world around them.

Taking an interactionist view, I conceive of these beginning teachers as active and agential. They began their teacher education program with unique permutations of understandings and experiences that they drew on, along with current experiences of recruitment, preparation, and practice, to make sense of themselves as teachers. Their development occurred within a set of situations – and social interactions – that partially shaped their perspectives on math teaching and themselves as math teachers

over the course of the study. This theoretical and analytical approach required attention to both the teacher candidates, as individuals, and the shared meanings of math teachers and teaching constructed throughout the social/figured worlds of math teacher recruitment and preparation, as well as the middle and high schools where they taught.

Understandings of what it means to be a teacher are embedded in, constructed by, and reshaped through language and symbols. Applied to the teacher candidates, this active view of the individual focuses attention on the discourses, texts, and symbols simultaneously shared and individually mediated. They both authored – and were authored by – the discourses and situations they participated in. The teacher candidates' biographies and understandings of math teaching interacted with the ways that math teachers' work was represented through the figured worlds of math teacher recruitment and preparation -- and at the school sites. The roles and subject positions that were available for the teacher candidates were embedded within social-cultural-historical understandings of teachers and teachers' work. Analytically, I attended to the perspectives held and positions that the teacher candidates took up as they articulated themselves as math teachers.

Grounded Theory

Grounded theory is the primary methodology for my research. Grounded theory refers to a general methodology for developing theory from data that is systematically collected and analyzed. Doing research and generating theory are two parts of the same process. "The act of theorizing is not an imposition of abstract

theories upon vacuous conditions. Theorizing is a form of engagement with and intervention in the world. Theory always lives in the in the practical experiences of us all and yet must be interpreted as a source of intervention" (Britzman, 2003, p. 69, italics added for emphasis).

While grounded theory shares similar data sources (e.g. interviews) and modes of analysis with other qualitative methods, it is different because of the emphasis on theory development. As Glaser (2003) noted, grounded theory is not merely descriptive, but it is a study of a concept. So, the focus is on substantive, rather than general, themes. According to Strauss and Corbin (1997) the theories produced are "*plausible* relationships among *concepts* and *sets of concepts*" (p. 278). Grounded theory guides researchers to propose 'conceptually dense' theory – it is not solely about the individual actors, but patterns across them. There is an interest in understanding what happens under certain conditions – by exploring processes, not linear or unidirectional cause-and-effect relationships. Strauss and Corbin (1997) asserted that the theories developed a

> call for exploration of each new situation to see if they fit, how they might fit, and how they might not fit. They demand an openness of the researcher, based on the 'forever' provisional character of every theory… [grounded theories] are systematic statements of plausible relationships (p. 279).

This approach outlines iterative analytical strategies for coding and analyzing data that began early in the data collection process and continued through the writing. Important for me is the understanding in grounded theory that the researcher constructs "a world *made real* in the minds and through the words and actions of its

members … [she] constructs an image of *a* reality, not *the* reality – that is objective, true, and external" (Charmaz, 2003, p. 273).

Analysis begins as soon as there are data. It is a recursive process, moving from codes to categories to theorizing and back again. As Clarke (2003) asserted, grounded theory about the phenomenon of concern "is composed of the analytic codes and categories generated in the analysis of the substantive area that is the focus of the research project – a 'substantive theory'" (p. 557). This approach to analysis allows the researcher to then theoretically sample data as the study continues and positions data collection and analysis as active engagement, using early analysis to guide future data collection.

Situational Analysis

Situational analyses (Clarke, 2005) complement basic grounded theory with situation-centered approaches that enrich research by addressing and engaging important postmodern theoretical and methodological concerns about differences and complexities of social life (p. 558). It extends the notion of the 'knowing subject' and attends to the *situations,* inclusive of discourse, in which the subject participates. The concept of situation includes, but also extends beyond immediate face-to-face interactions, to include "pertinent institutional and other meso/macro social formations" (Clarke, 2005, p. 34).

While traditional symbolic interaction research has focused on localized (and some have argued, de-politicized) interactions, Clarke's configuration of situational analysis calls on cultural studies as well and requires the inclusion of discourse

analytics used on and with a wide range of data to explore not only the immediate set of interactions, but also the discourses, which she argued *constitute* the situation. It is a conceptual guide useful in developing a research plan. Clarke (2005) identified attention to *perspectives* as a particularly postmodern aspect of Symbolic Interactionism because it "involves the commitment to representing those we study on their own terms" (p. 1).

Defining the situation: social worlds, figured worlds.

Sociolinguists Bucholtz and Hall (2004) critiqued previous research on identity for having the assumption that "identities are attributes of individuals or groups rather than of situations" (p. 376). The situated aspects of identity are central to this study. I use the concept of social worlds as a way to explore the situations in which identities are formed and reshaped.

Clarke (2005) built on Strauss' work (1978) to re-introduce the concept of social worlds as "groups with shared commitments to certain activities sharing resources of many kinds to achieve their goals, and building shared ideologies about how to go about their business" (pp. 45-46). They are characterized by "at least one primary activity, particular sites, a technology (inherited or innovative means of carrying out the social world's activities)" and, once developed, are typified by formal organizations (Clarke, 2005, p. 46). Clarke's analytical conceptualization of social worlds parallels Holland et al's (1998) theoretical conceptualization of figured worlds which they framed as "a socially and culturally constructed realm of interpretation in which particular characters and actors are recognized, significance is

assigned to certain acts, and particular outcomes are valued over others (p. 52). For the purpose of this dissertation, I consider math teacher recruitment and preparation as a kind of figured world which overlaps (interacting, connecting, contradicting) with the figured worlds of math teaching in middle and high schools (see Chapter Four for a descriptive analysis of these).

Social worlds' maps are both conceptual and analytical tools. They can be used to help conceive of the social worlds of interest and direct attention towards specific sites and sources within and among them. However, it is also an intermediate-level analytical tool allowing researchers a visual way to map *coded* data, locate parts of the social world, and find relationships among the various parts. As an analytical tool, social worlds maps allow us to represent and ask different kinds of questions of our data, such as "what are the patterns of collective commitment and what are the salient social worlds operating here" (Clarke, 2005, p. 110).

The notion of a social or figured world simultaneously highlights the cultural and institutional domains as they interact with meso- and micro- dimensions. The meso-level consisting of "action/negotiation/discourse/practice produces, under historically specific 'conditions of possibility,' subjectivities, collectivities, and discourses" (Clarke, 2005, p. 59). Whereas micro refers to the actions of individuals. Subjectivities, collectivities, and discourses around teachers and teaching are produced at this meso-level where these 'conditions of possibility' shape the process(es) of being and becoming a teacher. Holland et al (1998) noted that figured worlds are a "socially and culturally constructed realm of interpretation in which

particular characters are recognized, significance is assigned to certain acts, and particular outcomes are value over others" (p. 52). So, the available subjectivities, replete with conditions and expectations for behavior, outcomes, and even identities come to dominate these social/figured worlds.

As Clarke (2005) argued "[t]he conditional elements of the situation need to be specified in the analysis of the situation itself as *they are constitutive of it*, not merely surrounding it or framing it or contributing to it. They *are* it" (Clarke, p. 71). Attending to the situation allows researchers to attend to the *salient* parts of the social worlds/arenas – not all parts of them. Focusing on individual beginning teachers means that they directed my inquiry towards the salient parts, *salience* as determined by the teacher candidates through interviews and observations. While a researcher might define a social world of interest prior to the study, they would not decide a priori all that would be included in one's analyses and representations of it.

Beginning Teachers as the Research Focus

For this research, I located the main focus of my inquiry as the beginning teachers who, in authoring their teacher identity, select from parts of the social/figured worlds in which they participated to influence their iterative process of becoming and developing as teachers. As Britzman (2003) noted in her seminal research on learning to teach, "attending to the voice of teachers attempts to remedy the traditionally imposed silences of research subjects as primarily spoken about but rarely speaking for themselves" (p. 66). However the work here is less interested in personal viewpoints or reflections but more so Britzman's (2003) focus on

"understanding what they make happen because of what happens to them and what it is that structures their practices" (p. 70).

The research described here is bounded in the sense that I presumed that interaction with the social worlds math teacher recruitment and preparation and middle/high schools would be important sites of professional identity development. However, locating the focus of the research on individuals (rather than programs or schools) allowed the research design to be open as I explored the sources that the beginning teachers identified as pertinent. I am interested in how the math teacher candidates' subjectivities (and consequently identities) are shaped by the conditions of teaching and learning. "Just as culture is always in the process of being reinvented, renegotiated, and reinterpreted by its participants, so too are the signifying processes of school life" (Britzman, 2003, p. 71).

Data Collection Methods

The data for this research came from a variety of sources but were primarily focused on language and text. As Charmaz (2014) noted, "[d]iscourses accomplish things. People not only invoke them to claim, explain, and maintain, or constrain viewpoints and actions, but also to define and understand what is happening in their worlds" (p. 85). This approach was consistent with both the conceptual and methodological frameworks. Taking the view that people interact with self, others, and the environment to develop a professional identity highlighted the need for data that would illuminate different aspects of the social worlds in which the teacher candidates participated. (See Table 3: *Data Sources*).

Table 3: *Data Sources*

Interviews	• Three math teacher candidates over six years • Three interviews each during the credentialing year • Four more interviews over their first five years of teaching
Survey	• Initial survey administered to eight potential study participants
Field Notes	• 2009-10: all five academic quarters • Student Teaching Placements • University courses and student meetings
Document Collection	• Syllabi • Supplementary Course material • Teach STEM materials • University materials • School site materials
Supplemental Artifacts	• Internet and school district data on student teaching school sites and the schools where they were employed

Interviews as the primary data source

The primary source of data for this study was intensive interviews – a type of qualitative research interviewing from grounded theory. "Intensive interviews focus on research participants' statements about their experience, how they portray this experience, and what it means to them, as they indicate during the interview" (Charmaz, 2014, p. 58). This approach views interviews as a particular kind of interaction where the researcher has a topic to pursue while the participants have their own goals or problems to solve. Everyone has assumptions, priorities, and particular knowledge bases that come to bear on these interactions. "Intensive interviewing focuses the topic while providing the interactive space and time to enable the research participants' views and insights to emerge" (Charmaz, 2014, p. 85).

The participants for this research were interviewed a total of seven times – three times in the initial year and four more times over the course of their first five years of teaching. (See Appendix B for the teacher candidate interview protocols.)

Taking a symbolic interactionist approach to the intensive interviews, I viewed the research interview as both a productive and referential activity. While meaning is made through interaction, the content of the interview refers to the social worlds and situations that are of interest and the meanings that people ascribe to these. Treating the interview

> as a social encounter in which knowledge is actively constructed suggests the possibility that the interview is not so much a neutral conduit or source of distortion, but rather a site of, and occasion for, producing reportable knowledge" – and means attention must be paid to both the form and content of the interview (Holstein & Gubrium, p. 141).

To do this, I employed a number of strategies. Consistent with other approaches to qualitative interviewing, the interview protocols set up semi-structured, open-ended interviews (see also Schensul, Schensul, and LeCompte, 1999) with each of the beginning teachers. At times, I used modes that veered from the typical 'question and answer' format drawing on interpretive resources such as card sorts (Grossman, 1990) and concept mapping (Novak & Gowin, 1984) to engage participants with during the interviews. I drew the material for these (e.g. the words to go on a card sort focused on conceptions of teaching; the topics for a concept map) from other data collected, attending to the need to both refer to the social worlds of interest and leave openings for students to direct me towards other sources. This strategy connects to the idea

that "[m]eaning is not constantly formulated anew, but reflects relatively enduring local contingencies and conditions of possibility" (Holstein and Gubrium, p. 149).

After the first year of data collection, interviews continued to address the beginning math teachers' biographies but with increased attention to the ways that constraints and affordances of teaching as a career and at their school site in particular interacted with their ongoing teacher identity development. Focal topics in these interviews including the beginning math teachers' perspectives on teaching and themselves as math teachers, induction, ways they were evaluated (formally and informally), career plans, and school context specifically with attention to the school as a workplace, department culture, the administration, curriculum, requirements as a teacher, fit between person and site, among others.

Other Data Sources

Survey.

As referenced earlier, I administered a survey as part of the participant selection process. In the survey, I posed a range of open-ended questions to gain an understanding of the beginning teachers' pre-service experiences, reasons for selecting teaching as a career and their particular preparation program, along with conceptions of teachers generally, and of themselves as math teachers. (See Appendix A: *Survey*.) I analyzed the data from the survey using a content analysis approach.

I initially planned to use the survey to help in participant selection (with the goal of selecting the most diverse pool) and did this. However, the data from the survey itself became an important source of initial understandings about the

candidates in terms of their own schooling, experiences as a student, pre-professional experience, as well as perspectives on themselves as future teachers and career plans. In fact, the teacher candidates' perspectives quite durable between the start and end of the teacher preparation program. So, as the research and analysis progressed, the survey was included in the iterative phases of data analysis as described in this chapter.

Observation/Field notes

The observations for this research occurred during the first year of the study and focused on the beginning teachers in the classrooms where they completed student teaching. I observed each teacher candidate in their student teaching classrooms for three separate lessons. The observations generally extended over a few days to observe the development of a lesson or unit of study. While on site, I also observed the teacher candidates in non-instructional work and activities (e.g. faculty meetings, informal discussions, etc.,). At Cliff University, I attended classes, meetings, and events (e.g. orientation, faculty meeting, class session) where the candidates were participants.

To document the observations, I employed 'thick description.' Emerson (2001) described thick description as moving beyond writing down all of the 'facts' of the setting or action, "the key to thick description lies not in reporting, collecting, and assembling 'facts,' but in *interpretively* understanding and representing the subtleties and complexities of meaning" (p. 33).

Document Collection

I collected documents from the various organizations that comprise these social worlds (e.g. course syllabi, admissions materials), documents produced by the student teachers in these social worlds (e.g. class assignments, lesson plans) and in interviews, and documents that referred to and/or influenced these social worlds (e.g. newspaper articles, policy documents).

As archeologist Hodder (2000) pointed out in his writing on document and artifact analysis, documents must be analyzed in relationship to the situations in which they were created – including context, purpose, and intended audience. He wrote, "[u]ltimately material culture always has to be interpreted in relation to a situated context of production, use, discard, and reuse" (p. 706). They can be analyzed on their own; use to inform interview protocols or as a shared interview resource.

The bulk of document collection and analysis was on Teach STEM and the teacher preparation program at Cliff University because, following the candidates' interview data, these were and remained contexts of importance for them and their identity development. I concur with Walshaw (2004) who, drawing on Foucault, asserted that there really is not an origin point in teacher development. So, these contexts are less about defining a true beginning point for teaching and more to better understand a critical context of entry and development in general, and one that was referred to often as the candidates made sense of themselves through their work as teachers. I also collected and analyzed documents from and about the schools where

the candidates ended up teaching; however, these were primarily internet-based and focused on publicly available data about the schools.

Data Analysis

In this section, I introduce the analytical methods – and associated tools – that I used to guide collection and analysis of data for this research. As mentioned, the methods I draw from are primarily grounded theory (Glaser and Strauss, 1978; Charmaz, 2003) and situational analysis (Clarke, 2005).

Sociologists Atkinson and Coffey (2003) in their work on the relationship between interviewing and participation wrote that "the research methods we use imply or depend on particular kinds of transactions and engagements with the world. Each kind of transaction therefore generates a distinctive set of descriptions, versions, and understandings of the world" (p. 115). From this perspective, multi-sited, multi-level data cannot merely be aggregated to reveal the 'truth' of the worlds being explored. They (2003) asked, "If we cannot simply add them together and superimpose them to make a single coherent narrative or picture, what are the proper relations between them?" (p. 116). They argue, as do I, that each set of data needs to be treated as revelatory of certain understandings of, and enactments in, the social world. Each provides a window into that same social world allowing us to discern, as educational philosopher Maxine Greene (1995) did, "that the world perceived from one place is not *the* world" (p. 20).

"When practices become a text, they must be read not as guarantees of essential truths, or recipes for action, but as *representations* of particular discourses

that implicate the voices of teachers and researchers in larger interests and investments" (Britzman, 2003, p. 67). These must be read through the lens of authority or we may run into the issue of mistaking personal experience for theoretical truths.

In this section, I summarize the analytical methods I used to understand the data collected, The three iterative phases of data analysis allowed me to (1) consider each source of data separately during the early phases of analysis, (2) use specific analytical tools and matrices, and (3) locate the relationships among these.

Phase One: Initial to focused Coding

From a grounded theory perspective, coding moves the researcher from restating the data to making analytical and theoretical sense of the data. Coding allows you, on one level, to define what is happening but also to grapple with its meaning. It is a way of abstracting from the data a kind of relationship that extends beyond the finite segment of text. "A code sets up a relationship with your data and your respondents" (Star, 2010, p. 80).

Initial Coding.

The initial coding phase is one where the researcher analyzes early data with an eye towards analytical ideas to pursue as the study develops. In this analytic phase, codes focus on actions in the data. This process allows you to understand what the participants see as important or possibly problematic. So rather than collapsing early analysis into preconceived ideas or developing one-dimensional portraits of the

participants as certain 'kinds' of people, the focus on action allows new ideas to emerge. Charmaz (2014), in her work on grounded theory, suggested that another way to approach the initial analysis is to use sensitizing concepts which include action but can also be "meaning, process, agency, situation, identity, and self… Initial codes are provisional, comparative, and grounded in data" (p. 117). This can be used as by an individual researcher, taking different lens and asking a variety of questions of the same data or used in group configurations (such as Strauss' 1987 concept of working groups) in which multiple people code the same data to see the multiplicity of possible interpretations. For this research, I used both of these strategies to different degrees.

This initial coding was done in a line-by-line approach, locating actions, specifically, and sensitizing concepts more broadly to pull apart narratives and events which helped to focus later interviews. As I did this, I found that particular ideas or experiences repeated consistently and this led to the next phase of data analysis, focused coding.

Focused Coding.

Focused coding aggregates the breadth of initial coding to concepts that helped to "synthesize, analyze, and conceptualize larger segments of data" (Charmaz, 2014, p. 138). Drawing on initial coding and memos, I developed both framing and then focused codes to support analysis. Framing codes set up general areas of inquiry (here, knowledge, person/self, and perspectives) where the focused codes focused on different aspects of each of these.

Table 4: Focused Coding Scheme

Framing Code	Focused Code
Knowledge	Curriculum
	Educational Contexts
	Educational ends, purposes, values
	General Pedagogy
	Math
	Learners and their Characteristics
Person/Self	College experience
	Family/community background
	Future self
	Influence/support to teach
	Interpersonal/peer group
	K-12 history
	Professional goals
	Race, class, gender
	Reasons for entry into teaching
	Relationships with teachers
	Teaching Experience, not iSTEM
	Work history (not teaching)
	Experience with math
Perspectives on	Long range view on teaching/career plans
	Self as a student of teaching
	Mathematics
	Students
	Teachers (general)
	Teaching and Learning, general
	Teaching and Learning mathematics
	Where to teach

Analytic/comparative memos.

Memos are analytical – making sense of the data, not merely describing it – and move towards comparison, what Glaser and Strauss (1967) referred to as the 'constant comparative method.' Along the way, I wrote analytic/comparative memos while I was coding.

Phase Two: Focal student portraits

Drawing on the focused coding and ongoing analysis, in Phase Two I defined emerging patterns among these, and did a complete coding and analysis of all relevant data sources to develop a portrait of each focal student during their teacher preparation year. The portraits included a written description of their personal, familial, and academic history prior to the study and emerging patterns from the six years of data. These portraits helped to provide an understanding of the students and their experiences. After a number of analytic attempts to makes sense of the data, it turned out to be the portraits of the beginning math teachers that were best matched to both the identity focus of this research and the abundance of interview data specifically.

Integrating this meant that the ways the beginning math teachers spoke about themselves as teachers in relation to the contexts where they were recruited, prepared, and practiced teaching were of central importance. For each teacher, I examined the focused categories to find emerging patterns over the course of the initial, teacher education year. Using Glaser and Strauss' (1967) *constant comparative method* I located topics, perspectives, process, inquiries, etc., that repeated in each teacher candidate interview or observations/field notes. For example, Pierce made continual references to his own preference for ease, going so far as to define himself as 'lazy' in comparison to the other members of the cohort. This was not a singular reference but an idea he explored about himself from discussion of himself as a K-12 student, to his selection of a major, development as a beginning teacher, and so on.

Part of developing the portraits of the candidates allowed me to find ways that they spoke about themselves or processes they were engaged in that were fairly similar across candidates, pointing to what was shared, situational, and perhaps even institutionalized to those aspects that were not. These portraits were both reflective of their prior history/biography and hence referential to a time before the study and also proceeded by summarizing and analyzing changes that occurred over the course of the credentialing year by considering some of the following aspects at the beginning, middle, and end of the year:

- Experiences as a student and teacher of math specifically
- Perspectives on math teaching
- Perspectives on Teach STEM and the credential program at Cliff
- Perspectives on students
- Reasons for becoming a teacher, specifically through the program at Cliff
- Perspectives on themselves in the cohort (roles)
- Descriptions of themselves
- Perspectives on the schools where they completed the bulk of their student teaching
- Career Plans

From these various vantage points through interviews and the other data sources, I assembled and wrote the candidates' portraits. I used these descriptive portraits as a way to represent and also analytically understand both their teacher identity development over the course of the first year in the program and to develop a

framework to understand the ways the candidates changed as they moved from students of teaching to teachers of students.

Analyzing the various data sources revealed both emic and etic views of the candidates' professional identities—meaning those aspects of their identity as described by the candidates about themselves and those perceived by others (myself, other project researchers, program staff and faculty, as well as mentor teachers). As part of this analysis, I attended to my role as a participant observer. While I was someone with close connections to the programs that prepared them and looser ties to the schools where they were mentored and later employed, I took care to distinguish my role as a researcher from that and they knew that I would not evaluate them in any capacity. Given the candor in their responses, including discussing strategies and perspectives that were, at times, specifically opposed by the programs they participated in I was confident that, to the extent possible, we achieved a level of comfort and transparency. I felt confident that candidates' responses were honest, critical, and self-reflective. Although I originally planned to present the data for this study primarily by themes, I chose to return to these detailed portraits for the final data (re)presentation. This is described in Phase Three below.

This analytical phase included a host of sub-questions that I drew on for analytical support such as: How do the Teacher candidates define the situations in which they find themselves? How do they define themselves within those situations? What are the individual and group definitions for math teaching? What is the process (or set of processes) by which these definitions develop and/or change? Do teachers in the same

situation (or set of situations) define teaching differently? What is the relationship between these individuals' definitions? What is the relationship between the way that these teachers define the situation (or set of situations) they find themselves in and how they enact themselves as beginning teachers?

Phase Three: Comparison across students, model development

Although, as I will discuss in the next section 'Presentation of Findings' I ultimately chose to present three of the focal teachers in narratives rather than in chapters separated by theme, the process of discerning what went into each narrative was an analytical process, not merely a descriptive one. In this section, I describe some of the analytical steps that led to the chapters that come after this one. In this third phase of analysis, I developed a comparison across students in several ways.

I began with the initial portraits of the candidates and the subsequent five years of interview data to examine the emerging patterns from each student and compared them across all of the candidates in a few ways. The patterns then became new categories for comparison. I compared the beginning math teachers across categories to look for similarities and differences. For similar cases within a category, I outlined properties for each category to define it. For example, "success in math as predictor of fit for math teaching" was an emerging pattern among the candidates. I found that all of the candidates described that their own success as a math student (generally in middle and high school) as something that distinguished them from their peers and positioned them as math teachers.

What was interesting about this category was that it was not only self-descriptive but also relational as it both provided coherence to their selection of a career but also defined this capacity as unique and 'special' which led to other categories such as "math as exclusive" as they positioned themselves against their K-12 peers and, at times, in connection and contrast to the middle and high school students they taught. As I moved between portraits, interviews, and other data between the candidates and the categories using Glaser and Strauss' constant comparative method, I found relationships amongst the categories. As Hallberg (2006) wrote in her work on the constant comparative method,

> every part of data, i.e. emerging codes, categories, properties, and dimensions as well as different parts of the data, are constantly compared with all other parts of the data to explore variations, similarities, and differences in data… [it] is strict enough to be helpful to the researcher in exploring the content and meaning in the data, but not saddled with so many strict rules to be too rigid for a grounded theory researcher (p. 143).

To support my comparative analysis, I used the student portraits and coded interviews in Dedoose. Dedoose is a web-based qualitative research software. The portraits became a memo in and of themselves – an analytical description of the candidates' developing teacher identities referring back to their time in Teach STEM through the yearlong credential/master's program. With Dedoose, I explored specific codes and categories that were relevant to their individual and shared experiences and perspectives, as well as the related analytic memos. I used these analyses and memos to analyze emerging patterns across all the candidates. I cross-checked the full interviews, portraits, and memos with the Dedoose reports. To gauge the density of the codes with individual candidates and across the focal candidates, I created several

frequency reports of categories using Dedoose. Following Charmaz (2014), I treated recurring interview statements as theoretically plausible.

In addition, I created a matrix of student responses from key interview topics. For each relevant response, I noted the interview where it occurred to see variation both within students and across students at specific points in their program and teaching career. To explore relationships among the candidates, I moved between the matrix, the interviews, and observation notes to confirm evidence.

Presentation of Findings

As discussed above, I present the data analyses for this research in the form of developed narratives about three of the focal beginning math teachers followed by a chapter where I unpack some of the salient findings. To guard the anonymity of the candidates, I changed their names, the name and location of their undergraduate and teacher preparation programs, as well as the schools where they taught. When I included quotations from interviews and other data sources, I attempted to keep the structure of what they said and how they said it intact while also removing excessive filler words such as "like" and "uh" to create more ease for the readers of this text. I did this especially when the wording made it difficult to read and understand the quotation. However, I did not grammatically revise their words in any way. I felt this kind of editing moved away from ease of reading to altering what they actually said. At times I reference their feelings, which is particularly salient for this work given the relationship between teacher identity development and emotions (c.f. Zembylas &

Schutz, 2016). Please note that all representations of emotions came directly from the participants' words as I did not infer emotionality on their experience.

Role of the Researcher

One of the dilemmas of developing and engaging with this research design has been to explore how what I 'see' when I enter data collection, and the concurrent analysis, will not be just be what I thought I would see. To attend to this, I selected a rigorous set of methodologies designed to help de-center my own perspectives. From my sampling technique, focused on variation, to the array of data, and multiple modes of analysis, I hope that what I achieved in this design, at the very least, is one that disrupts and challenges my own thinking, and forces me to consider these social worlds differently. In this research, I move at least one step away from triangulation – which tends towards one coherent account – toward to the idea that each set of data may "generate a distinctive set of descriptions, versions, and understandings of the world" (Atkinson and Coffey, 2003, p. 114).

However, I understand that I am still the instrument through which data was collected, transcribed, analyzed, and then written about. Of all the variation that I have purposefully integrated into my research design, I remain the single point of consistency throughout. So, while I will not make any claims about a 'proven' technique that will make me perfectly reflexive, here are some of the ways I worked on personal clarity as I moved through the research process.

In addition to the analytic/comparative memos I kept a personal journal to describe my own experiences, responses, and understandings as I journey through this

research. *For example, how do I conceive of math teachers and teaching? What did I value and how did that change through the research process?* And, during the data collection phases, I participated in a research group focused on teachers and teachers' work. I brought research material – protocols, transcribed data, memos, and/or analyses – to discuss with others and actively question my own biases and partial understandings.

Over time, I had to account for and reckon with my own pedagogical and identity hopes for the candidates. This was, at times, an analytical lens of itself, one that was more a lens of judgment than thoughtful critique. Based on earlier research, I envisioned the candidates becoming teachers as well as change agents which would have required that they took a very critical pedagogical stance toward their teaching. In the main, this was not true. They were thoughtful beginning teachers with varying conceptions of their practice, their students, and themselves as teachers. Some of these aspects were durable, others shifted regularly. Letting go of that hope for them allowed me to explore the richness and complexity of who they really were and what they came to offer themselves and their students.

Limitations of the study

There were five main limitations to this study. First, while I did not set out to do generalizable research, it seems to pertinent to clarify that point there. The findings, though interesting and certainly helpful in framing other research is not generalizable to other teacher candidates or recruitment and preparation programs. I focused on the biographical, programmatic, and situational influences on these beginning teachers'

developing teacher identity as they traversed through a specific undergraduate major, recruitment, and teacher preparation program. Given the size of the program, the sample size for this work was very small. While I hope some of the theoretical implications may be applicable to similar programs, more research is needed.

Second, given that the majority of the candidates participated in the Teach STEM program (eight of the ten math candidates) and most of those received external funding (seven of those eight), I decided to focus on those who went through this specific pathway and locate similarities and differences in experiences, perspectives, career plans, and identity development. Even if I had not made this data reduction choice, only one candidate in the Cliff master's/credential program volunteered to participate in the study who did not move through this particular pathway. This would not have allowed for a balanced data set or a fair comparison. This meant that I was not able to compare those who participated in the Teach STEM and received funding with those who did not. Also, even though the Teach STEM program came up repetitively over the course of the six years of the study, I did not interview or observe the candidates during this time so this meant that I had to rely on their memories to reconstruct some of their experiences in Teach STEM. Other cross comparisons would have been ideal, for example comparing both STEM Scholars and non-STEM Scholars across entry years at Cliff University and possibly compared with STEM Scholars and non-STEM Scholars at other universities.

Third, to do identity-focused research required that I attend to the candidates as holistic beings, not solely teachers. While I did address their biography and prior

experiences through interview questions, I did not follow them into other aspects of their lives. The interviews focused on self-reported data and this can be seen as a limitation of its own. As I mentioned above, I did my best to hold interviews and observations as non-evaluative spaces. While there may have been some level of 'impression management' it seemed to also be based on their assumptions of what they perceived to be important to me (Goffman, 1959). I do not want to discount that. However, it is important to note that, ultimately, these notions of salience or importance kept pointing back to their own experiences and development. For example, Carmen's repetitive focus on 'control' of her students and 'English learners as ideal students' were not at all reflective of my own pedagogical preferences but were repeated often enough so I could discern that they were in fact her own priorities.

Fourth, there was a limitation in data collection. This was initially a one-year study focused on the teacher preparation year however it expanded to a six-year study. This was simultaneously a benefit and a constraint. Of course, it becomes a more beneficial study to explore the candidates as they moved forward in their career. It was also a challenge to parse through what was both a narrow (number of participants) though deep (length of time) data set. Although it is not all represented here in this one dissertation, there is a wealth of data that came from this project that allows us to begin to understand the relationships between biography, recruitment, preparation, and school context in career decisions for beginning STEM teachers.

Fifth, is less of a limitation of this work in particular but a hope that I will also address in future directions for this research in chapter seven. Given the centrality of context in the candidates' developing teacher identities, more observation data (possibly even ethnographic) and/or interviews with significant others such informal and formal mentors, colleagues, administrators, families, and students at the schools where they were hired would have been ideal.

Chapter Four: Introducing the Sites of Teacher Recruitment and Preparation

"[A] number of studies have offered empirical evidence that teacher education programs that have coherent visions of teaching and learning and that integrate related strategies across courses and field placements, have a greater impact on the initial conceptions and practices of prospective teachers than those that remain a collection of relatively disconnected courses" (Darling-Hammond, Hammerness, Grossman, Rust, & Shulman, 2005 p. 392).

In this chapter, I address the entry contexts – Teach STEM, STEM Scholars funding, and the credential program at Cliff University as a unique kind of pathway to teaching. The focus on classroom practice is a point that I will explore here as it came to bear heavily on the candidates' development.

Over the course of the study, I came to understand that these recruitment and preparation pathways were not merely sequential aspects of a career pathway but actually comprised (or perhaps laid the groundwork for) what Ken Zeichner (2010) referred to as a 'hybrid' or 'third space' program itself. Drawing on Homi Bhaba's (1990) work on hybridity, Zeichner introduced 'third spaces' as those that "involve a rejection of binaries such as practitioner and academic knowledge and theory and practice and involve the integration of what are often seen as competing discourses in new ways—an either/or perspective is transformed into a both/also point of view" (p. 92). Applied to the programs that formed the entry context for the candidates who are the focus of this study, third space and hybridity help point to the ways that school-based and university-based teacher educators brought together different (yet overlapping) bodies of knowledge to inform teacher preparation. I am not arguing that the theory and practice lines were blurred, but that the presence of Teach STEM

specifically interacted with the credential program in a way that privileged field experience and practitioner knowledge beyond what is often typical in teacher preparation programs.

In his writing on this, Zeichner addressed the possibilities that hybridity might offer teacher preparation if practitioner (school-based) and academic (university-based) knowledge bases and practices could be combined without assuming the usual primacy of university knowledge.

> Contrary to the traditional disconnection of campus and schools and to the valorization of academic knowledge as the authoritative source of knowledge for learning about teaching in traditional college and university models of teacher education (Smagorinsky et al., 2003), third spaces bring practitioner and academic knowledge together in less hierarchical ways to create new learning opportunities for prospective teachers (Zeichner, 2010, p. 92).

He challenged the traditional form of integration which has been to bring 'university' knowledge to the PK-12 settings which positions university teacher educators as having expertise, perpetually reifying the notion that classroom- and school-based educators do not. "Creating third spaces in teacher education involves an equal and more dialectical relationship between academic and practitioner knowledge in support of student teacher learning" (Zeichner, 2010, p. 92). The recruitment and entry contexts for these math teacher candidates could be viewed as an example of or experiment with third space which is typified by boundary crossings. Here,

> an effort to bring academic and practitioner knowledge together in a more synergistic way in support of student teacher learning… these [are] experiments in shifting the epistemology of preservice teacher preparation from a place where academic knowledge in the university is seen as the primary source of knowledge about teaching to a situation where academic knowledge and the knowledge of expert P-12 teachers are treated with the equal respect (Zeichner, 2010, p. 93).

As I will describe in more detail, Teach STEM was primarily a teacher recruitment program that grew specifically from a larger California policy and practice initiative to prepare more qualified science and math teachers. The practical dimensions of teacher preparation were emphasized and there was a strong focus on bringing people to the career that might not have considered it otherwise through financial incentives and exposure to the work of teachers and teaching. Given the centrality of school-based internships in Teach STEM, the focus necessarily privileged practitioner knowledge bases.

While the credential program certainly prioritized field work, it was from what Zeichner referred to as a focus on 'academic' knowledge, "the diverse forms of knowledge and expertise that exist among college and university faculty and staff" (p. 92).

> The implicit theory underpinning this tradition has been described by Britzman (1991) in terms of knowledge integration and implementation by beginning teachers in which the university provides the theory, skills, and

> knowledge about teaching through coursework; the school provides the field setting where such knowledge is applied and practiced; and the beginning teacher provides the individual effort that integrates it all. This tradition assumes that learning is an additive process that largely bypasses person and setting (Wideen, Mayer-Smith, & Moon, 1998, p. 133).

This separation of 'academic' and 'practical' knowledge bases, often thought of as the 'theory-and-practice divide' was codified in this pathway and I will argue later in this dissertation that this unique and extended entry context could be leveraged for more coherence and, actually, a disruption of this well-worn narrative about and approach to teacher preparation.

Figured Worlds of Math Teacher Recruitment and Preparation

Anthropologists Holland, Lachicotte, Skinner, and Cain (1998), in their book on identity and agency introduced the term 'figured world' to describe the sites, discourses, and practices through which meaning, and consequently identity, are made. In their work, figured worlds help bridge the micro-meso-macro gap by attending to discourses and practices shared and referred to by those being studied. They defined a figured world as "a socially and culturally constructed realm of interpretation in which particular characters and actors are recognized, significance is assigned to certain acts, and particular outcomes are valued over others" (p. 52). Meanings held in the figured world(s) for shared artifact, signs, etc., may be different than interpretations held by those who are from how those outside of the figured

worlds. Participants in the figured world have expectations for how events will unfold and shared expectations for behavior.

Figured worlds are contexts (real, symbolic, and imagined) that shape people as they come in contact with that world. They are "frames of meaning in which interpretations of human actions are negotiated" (Holland et al, 1998, p. 271). It is within and through these frames that certain positions come to be salient. People are recognized (and recognize themselves) as certain kinds of actors and attach significance to others' activities, outcomes, etc. They author themselves and, because figured worlds are created and re-created through work with others, they have the potential to re-shape the figured world(s).

Through their participation in figured worlds, people author their stories (and identities) making them available to themselves and others. Urrieta (2007) in his introduction to a special issue of The Urban Review focused on figured worlds in education research, wrote that people "are limited to varying degrees of accepting, rejecting, or negotiating the identities being offered to them" (p. 111). It is not a simple application of a label or just merely assuming a role – but really a process of how one comes to understand themselves in context and in relation to others. Holland et al (1998) noted that, in and through figured worlds, "people assume that their words and behavior will be interpreted according to a context of meaning – as indexing or pointing to a culturally figured world" (p. 52).

For the current study, I consider these figured worlds of math teacher recruitment and preparation which are populated with teacher candidates, professors,

field supervisors, classroom students, other faculty in the school, administrators, curriculum, etc.,

Teach STEM: Overview and Brief History

Teach STEM is a program in the Sciences division at Cliff University that developed out of a larger statewide math and science initiative in California that prioritized the preparation of 'highly qualified' math and science middle and high school teachers. The iteration of Teach STEM at Cliff University began in 2006 with the central goal to increase the number of qualified people entering STEM teaching from Cliff University. Building on the proposition by Rumberger (1985) that there should be strong pre-service preparation and alternative channels to attract STEM teacher candidates, Teach STEM focuses on field experiences, coursework, and advising to preview teaching for undergraduate STEM majors and minors. Although it shares some features of teacher education (field placements, access to education coursework), Teach STEM is primarily a recruitment program. That it is not a teacher preparation programs is an important distinction.

Coursework and field experiences are designed to support future teachers in making the link between teaching and learning in their chosen content area. Teach STEM offers financial support and career preparation resources, which I will discuss in the sections below. While traditional university-based math teacher education in California locates student teaching in the fifth, post-baccalaureate year, Teach STEM introduces these experiences as early as the first year in college. Typically, with a post baccalaureate teaching credential in math, candidates learn their content (e.g.

major or minor in math or math education) during their undergraduate years and then learn how to teach it in their fifth year. Teach STEM allows for a longer pre-service exposure period, ideally affording more time to understand the work of math teaching. However, this early exposure is not part of earning a teaching credential. It is a way to introduce teaching as a career primarily from the vantage point of teachers due to the focus on field experience.

This approach to recruitment is potentially useful in the case of math teaching where understandings of what it means to be a math teacher have been significantly revised through national reform initiatives (NCTM, 1989, 1998, 2000). These shifts moved math teaching from didactic, textbook-based learning to focus on collective processes and individual sense-making within a more discovery-oriented approach. Researchers argue that these shifts are often not consistent with how teaching candidates were taught as K-12 students and is consequently more difficult to implement as a beginning teacher (Borko, Peressini, Romagnano, Knuth, Willis-Yorker, Wooley, Hovermill, and Masarik, 2000; Nolan, 2006).

As part of the figured world of math teacher recruitment and preparation, Teach STEM provided both a path of entry to the career and a context through which the math teacher candidates developed understandings of math teaching and of themselves as future math teachers.

Table 5: Teach STEM Program Summary

Goals	To increase the number of science, mathematics and engineering majors who pursue secondary science or mathematics teaching careers.
Recruitment and Selection	Priority for STEM majors. Requires: application, essay, and good grades (GPA not specified), as well as a recommendation from a supervisor, professor, teacher, advisor, or tutor. The time and willingness to complete 24-34 hours in a field experience over the course of 10 weeks and attend a 2 unit course. Successful applicants who are STEM majors receive a small stipend.
Academic Preparation	Up to four quarters of field experience with increasing levels of responsibility as students advance in the program; completed in tandem with seminars designed to support placements.
Support Services	College and career advising. Student lounge and resource center for Teach STEM students with access to computers and printing as well as resource books (test prep, career books, general and STEM-specific teaching). Intern stipend which increased with each subsequent placement. Travel reimbursement.

Teach STEM: Recruitment, Selection, and Participation.

In line with the goal of drawing STEM majors to teaching, Teach STEM recruited from existing STEM majors and minors on the Cliff University campus. The math major at Cliff University is a relatively small one; it comprised only about 1% of campus undergraduates during the initial year of the study. In planning documents, the main issue that Teach STEM intended to address was increasing the number of students at Cliff who entered teacher preparation programs for math and science teaching. The focus to augment the pool of math teachers also meant attention to bringing more people to the math major since a 'substantial proportion' of the math majors at Cliff already plan to and do pursue math teaching as a career.

The formal Teach STEM recruitment process included personalized letters to STEM majors and visits to relevant STEM classes. The Teach STEM program was established during these teacher candidates' first year in college.

Carmen reported learning about it in classes, advising for her major, and through email invitation. Pierce found Teach STEM through his social networks. He described being drawn to Teach STEM primarily because of the classroom experience and funding tied to field experiences. He said, *"my friend, Jennifer, she took Teach STEM and she was telling me to take it because we actually got classroom experience and the big thing was, besides that, we got paid"* (Pierce, int. 1). Financial incentives to teach began with the candidates' initial field placements through Teach STEM and persisted through the funding of their teacher preparation program. Tanya was referred to Teach STEM when she was a Teaching Assistant for a math professor at Cliff University

Each of the candidates began Teach STEM in their third year at Cliff. Carmen and Pierce completed three (out of four possible) quarters of field experience; Tanya completed two quarters. Carmen and Pierce completed the STEM minor in Education and used their Teach STEM field experiences to meet some of the academic requirements for the minor. For Tanya, her experience in Teach STEM was auxiliary to her major in math but she did not pursue either the general or STEM education minor. Participation in Teach STEM afforded the teacher candidates financial and procedural support to apply to the MA/C program and, ultimately, access to STEM Scholars funding.

In organizational documents, potential candidates are considered as part of one of three groups. The first group, and also the main focus of Teach STEM, are those students who 'graduate' from Teach STEM (complete a B.A. in a STEM major, pass the California Basic Educational Skills Test (CBEST) and California Subject Examinations for Teachers (CSET) in their chosen content area, complete the required Teach STEM coursework and field experiences, take two or more Education courses, and complete the STEM minor) and are positioned to enter a teacher credentialing program. The second group of Teach STEM students are those who do not complete all of these requirements but are still qualified to enter a teacher credentialing program. The third group consists of those students who participate in Teach STEM and choose to not enter teaching. With these broad groups, Teach STEM generally serves more students in their first and second year in college – as not all of the students will pursue teaching and/or complete the program.

Teach STEM: Early Exposure, Support, and Financial Benefits.

Building on existing education-focused STEM majors at Cliff, Teach STEM articulated a program that provided a series of field experiences in local middle and high school STEM classrooms with associated seminars. Teach STEM students spend three to five hours each week in the classroom and progress in their responsibilities (from observation, to assisting, to teaching a part of the class in some cases). They enroll concurrently in a seminar where they have the opportunity to reflect on their field placements with an experienced practitioner. Students who are enrolled in STEM majors are given a small stipend for up to four field experiences. Ideally,

Teach STEM students complete the field experiences while also pursuing a STEM-related degree and the STEM Education minor. The STEM-focused minor is similar to the existing Education minor and includes three field experiences, two introductory education courses, and two upper division education courses focused specifically on the needs of future STEM teachers. The STEM education courses focus on math and science content standards, learning theories, and STEM-specific teaching strategies. A summer institute is available for advanced Teach STEM students.

The program is flexibly designed, but the ideal configuration is that students enter Teach STEM in their first year of college. This poses potential issues for attracting transfer students and those who change majors later in their academic career. The flexibility – although an appealing part of the program for college students – also meant that they did not have a consistent program but, rather, a self-direction. The candidates that are the subject of this dissertation began in their third year (two of whom changed academic majors over their time at Cliff) so they participated in the program as designed, though on a more compressed timeline.

Teach STEM: Academic and Career Support.

While enrolled in Teach STEM, students had access to career advising, teaching and teacher preparation resources, and a student lounge/study area equipped with computers and printers. Advising was available on a drop-in basis focused on academic planning for the STEM education minor and education tracks in STEM majors, financial information such as scholarships or loan forgiveness, tests required to enter credentialing programs and specific support to apply to program. Teach

STEM students also had access to CBEST and CSET test preparation, professional development events, summer internships, and support to apply to credential programs and for fellowship support.

Teach STEM: Pathway to Teaching.

With the goal of increasing the number of Cliff undergraduates qualified to enter a STEM teaching credential program, Teach STEM documents showed that students who want to teach are supported to apply for and attend the program at Cliff, programs at other colleges, and/or alternative preparation programs. This was confirmed by the candidates from this study.

Adding to the goal of growing the pool of those qualified to enter these programs was the related goal of expanding the number of credentialed STEM teachers who graduate from the MA/C program at Cliff. The long-term goal is to more than double the number of STEM graduates expanding from approximately 16 teachers in the math and science cohorts to a total of 40 to 50 STEM teachers. Although housed in separate divisions (Teach STEM is in the natural sciences division while the MA/C program is in the social science division), there is a clear relationship between the programs evidenced by the large number of Teach STEM students who enroll in the MA/C program. During the year of the study, eight of the ten math teacher candidates enrolled in the MA/C program participated in the Teach STEM program.

Funding through STEM Scholars: An Overview and Range of Programs

STEM Scholars is a federally funded program that provides funding to a variety of programs offered by institutes of higher education (IHEs herein) that support STEM undergraduates and teacher candidates to pursue teaching in high-need school districts. There is an explicit focus on recruiting qualified students who might otherwise not have considered teaching as a career. The priority is to fund programs that feature partnerships (1) between STEM and Education departments, (2) between IHEs and school districts, and (3) between excellent teacher preparation and induction support. As a recruitment strategy to increase well-qualified STEM teachers for "high need" schools and districts. It is a version of what Moran et al (2001) refer to as the "golden hello" (p. 27).

This funding, as it was used at Cliff University, provided scholarships for students enrolled in the math or science teacher preparation program for those who participated in Teach STEM, applied, and were accepted to both the Credential program and for this funding in particular. For each year of funding, students agree to work in a high-need school district for two years or they would be required to pay back the funding as it would convert into a loan. So, for these teacher candidates who attended the one-year Cliff University program and were awarded the STEM Scholars funding, they were required to teach in a high need district for two years.

Research on the larger STEM Scholars' programs, published in 2010, showed that 90% of the programs funded reported that they were able to augment their ability to recruit qualified STEM undergraduates and teacher candidates to teach in high-

need schools. 80% found that they could better recruit among typically underrepresented groups. School districts also reported augmenting their applicant pool of qualified STEM teachers in general and, specifically, more ethnically diverse candidates. They found strengthened relationships between school districts and IHEs. Issues faced across the programs nationally included: recruiting appropriate candidates, finding mentors, and finding suitable placements for graduates. Fairly early during the data collection for this group, most candidates indicated that they would have pursued teaching regardless of the funding. However, over the course of data collection and analysis, the candidates contradicted these early statements with repeated attention to the role of financial incentives in bringing them to Teach STEM initially, to pursuing their credential at Cliff, and leveraging their teaching in high need schools to qualify for additional financial support (such as student loan relief through the Assumption Program of Loans for Education, APLE).

Financial incentives such as the one focused on here are common. Jerald and Bosner (1999) reported that twenty-seven states have some form of loan forgiveness or scholarship program for prospective teachers. In fact, a variety of state programs provide funding for individuals to become certified in return for teaching in the state awarding the funds, such as the Massachusetts Mathematics and Science Teachers Scholarship Program (Clewell, Darke, Davis-Googe, Forcier, and Manes, 2000). Other efforts have attempted to expand the teacher pool by appealing to career changers (e.g. Troops to Teachers and programs focusing on paraprofessionals) or by portraying teaching as a civil service (Teach for America).

As mentioned earlier, despite their ubiquity, little is known about the influence of programs like this on recruitment, retention, decision-making, and career paths of prospective and practicing teachers (Guarino et al., 2006). In Imazeki's (2008) research on financial incentives they found that, with only one exception (c.f. Clotfelter, Glennie, Ladd & Vigdor, 2008), there was no research on the influence of financial incentives other than salary on the recruitment and/or retention of teachers. Scholarships and other financial incentives are believed to assist individuals who might be financially unable to further their education and/or to attract them to careers they may not have considered, but little research supports these assumptions. In the next chapters I will address the relationship between the STEM Scholars chosen career, path of entry, and career path decisions related to both the specific financial incentive offered by the STEM Scholars program as well as the Teach STEM program.

STEM Scholars: The Local Program at Cliff University.

The local STEM Scholars program was tied to Teach STEM. Teacher candidates must have participated in Teach STEM to be eligible for this funding. So, though a separate program, the local iteration is coupled with Teach STEM. As noted, while Teach STEM focused on expanding recruits to STEM teaching in general, STEM Scholars added the qualifier that they should teach in high need districts. Although these goals were complementary, the disconnect between them made it difficult to recruit candidates who participated in Teach STEM, wanted to stay at

Cliff for their credential program, and hoped to teach in high-need schools.[4] Of the initial group of five math teacher candidates, only two (Carmen and Pierce) expressed a clear intention to teach in high need settings. In fact, as noted earlier, at the conclusion of this study they remained teaching in high need settings, seven years post-credential. The other candidate focused on here, Tanya, began with conflicting perspectives about teaching in high need settings. She taught the requisite two years and then moved out of the state and taught in a charter school, taught out of the country in an international school, and later stopped teaching entirely.

Once admitted to Cliff University's MA/C program, Teach STEM students pursuing a math, physics, or chemistry credential could apply for and receive funding to support the completion of their credential. Six teacher candidates received this funding; five of these were math teacher candidates, one was a science (chemistry) teacher candidate. As noted previously, in exchange for funding the one-year program, teacher candidates agreed to teach in a high need school district for two years.

[4] Note that early analyses of the data for this study completed during the first year of program implementation allowed for programmatic shifts to occur later on that allowed for more coherence between programs.

Table 6: STEM Scholars Program Summary

STEM Scholars Program Goal	Support the recruitment and preparation of strong STEM teachers who will teach in high- need school districts
STEM Scholars Selection Criteria @ Cliff University	Must have completed at least one Cliff University Teach STEM undergraduate field experience and be completing a major in a physical science (chemistry, physics, earth and planetary sciences) or mathematics. Applicants are evaluated for acceptance into the MA/credential program, complete an interview with district partners and were selected according to these criteria: 1) general academic performance, 2) subject matter preparation, 3) a written statement of purpose, 4) evidence of writing ability, 5) letters of recommendation, 6) experience or coursework related to linguistic/cultural diversity, and 7) experience with youth or children in formal or informal educational settings.
Academic Preparation	Nothing specific to STEM Scholars. Teacher candidates participate in the MA/C program. Their course of study is indistinguishable from other math candidates.
Support Services	Invited to attend career development workshops and STEM Scholars Scholar functions (socials, annual meeting in Washington, DC, Western Regional STEM Scholars Conference). Formal and informal networks.

Cliff University

The teacher education program is situated in a public university in Northern California. The one-year program offered candidates a teaching credential and Master of Arts in Teaching. There is an emphasis on preparing teachers to serve the needs of diverse student populations and to become leaders of school reform. This goal is consistent with the focus of STEM Scholars as well. The program segments its students into cohorts—groups of students working towards the same type of credentials (i.e., multiple subjects, secondary English, etc.) who meet twice weekly in a student teacher seminar over the course of the academic year (August to June).

When I use the term "cohort" in this dissertation, I am referring to this specific group of math teacher candidates. The teaching supervisor leads cohort seminar and acts, essentially, as a bridge between university courses and student teaching. Due to low enrollment and significant budget cuts during the 2009-10 academic year, the math cohort was combined with science.

When they completed the thirteen-month program, the teacher candidates earned a California Preliminary SB 2042 single subject mathematics teaching credential and Master of Arts in Education. The MA/C program had as its primary goal to develop beginning teachers focused on equity who would understand themselves as change agents in school and social justice advocates to support reparations for historically underrepresented students. To meet these goals, the students took courses that included those on the sociological foundations of education with attention to teaching in diverse contexts. A noted strength of the program during this time, specifically, was preparing candidates to teach English learners in all subject areas. The math candidates also took research and methods courses in math education, as well as other courses on adolescent development, inclusion and special populations, technology, among others focused on their own development as teachers (see Table 7). This is a fairly typical lineup of courses for post-baccalaureate teacher preparation in California. Tenure-track faculty, lecturers, and, in some cases, PhD students taught these courses.

Table 7: Cliff University Program Features

Type	Public university Credential and Master of Arts in Education
Length	12 months
Size	~100 candidates
Admissions	Selective
Structure	Student teaching August-June; University courses throughout the program Weekly seminar meetings in cohorts: Fall, Winter, and Spring quarters
Courses for single subject mathematics credential	Teaching Learning and Schooling in a Diverse Society; Social Foundations of Education; Health, Safety and Community; Child & Adolescent Development for Educators; Beg/Inter/Adv Student Teaching; Methods of Teaching English Language Development; Teaching Special Populations; Math Education: Research and Practice; Introduction to Technology in Schools; Teaching Mathematics in Secondary Classroom; Portfolio Development; Reading & Writing Across the Curriculum
Additional courses for BCLAD	3 quarters of Bilingualism and Biliteracy
Field Experiences	August to June; about 7 months in the placement at the level (middle or high school) the candidate anticipates teaching upon graduation
Staff	Tenure-track faculty teach most courses; some courses taught by graduate students; supervisors are long-time teachers on loan from local districts
View of Teaching, Learning, and Schooling	The program emphasized preparing teachers to serve the needs of diverse student populations and become leaders of school reform. Privileged reform mathematics and constructivist pedagogies.
Social and Institutional Context	Embedded in a large public university with a history of progressive politics and activism; the Education department is part of the Social Science division.

How/Why Cliff University?

All of the eight original study participants attended Cliff University as undergraduates and described their positive experiences to partly explain their

selection of Cliff University for the credentialing process. Seven of those eight participated in Teach STEM and referred specifically to the role that the supports, early classroom experience, and funding played in selecting teaching in general and to pursue their credential at Cliff, more specifically. Although this is addressed in the candidate-focused chapter (five) that follows, a summary is relevant here. For Pierce and Tanya, eased access to the program, particularly with funding, was dominant in discussions about why they chose Cliff. Intermittently, they became reasons of their own for pursuing teaching in general as well as specifically selecting Cliff University. While Carmen also benefitted from Teach STEM's supportive approach, she did not present this as a reason to pursue teaching in general and/or the MA/C program at Cliff specifically. Rather, she leveraged these experiences to pursue the career she imagined and to remain in the region where she planned to start a family.

Student Teaching Placement.

Along with their coursework, math credential candidates completed an academic year of student teaching in both middle and high schools. The first placement (at either level) was approximately two months long while the second longer-term placement was about seven months long. The program recommended that candidates spend their longer placement at the level (middle or high school) that they anticipated teaching. In the longer placement, candidates taught for two periods,

worked with their cooperating teacher (CT herein) during preparation periods[5], and observed their CT and other teachers on site when they were not teaching or doing related tasks (e.g. planning). Candidates were placed in local schools and spent most of their placements in schools designated as "high-needs[6]." However, Pierce's long-term placement, although located in a racially and socioeconomically diverse middle school, did not meet the STEM Scholars criteria for "high need" schools. Most of these placements were in a primarily agricultural community with a large Latinx[7] population. Selection of school sites was guided largely by candidate choice. I include data below in Table 8: Second Placement Demographics to provide an overview of the schools where the bulk of the candidates' student teaching occurred.

[5] A preparation period, commonly referred to as a prep period, is a time scheduling within the school day for teachers to prepare instruction, analyze assessments, and complete other relevant tasks. This is more commonly found in middle and high schools than in elementary schools.

[7] In this dissertation I use the term "Latinx" in lieu of Latino or Latina (terms that reference Latin American cultural or racial identity). It is a gender neutral term in which the -x replaces the standard o/a ending in Spanish and Portuguese which are typically used to denote masculine and feminine genders of nouns, respectively.

Table 8: Second Placement Demographics (AY 2009-2010)

	Jordan HS (Tanya)	**Zuniga HS (Carmen)**	**Highland MS(Pierce)**
Number of students	2,119	1,460	591
API	673 (rank: 3)	657	837 (rank: 8)
Student demographics	0.5% African American 2% American Indian 1% Asian 0.9% Filipino 78.9% Hispanic/Latino 0% Native Hawaiian/PI 18% White 0% Two or more races 0.4% not reported	0.5% African American 0.2% American Indian 1% Asian 0.9% Filipino 78.9% Hispanic/Latino 0.1% Native Hawaiian/PI 18% White 0% Two or more races 0.4% not reported	0.5% African American 0.5% American Indian 3.1% Asian 0.8% Filipino 30.7% Hispanic/Latino 0.2% Native Hawaiian/PI 60.8% white 1% Two or more races 0.4% not reported
& Qualified for Free/ Reduced Lunch	77%	79%	39%
English Learners	36.6% EL 46% FEP	37.1% EL 57.2% FEP	6.1% EL 18.3% FEP
STAR: % proficient or advanced in Math	13%	39%	55%
Did the school meet their AYP goals?	No - did not meet AMO* in math or ELA; did not meet graduation target; EL and SES subgroups did not meet AMO	No - did not meet AMO in math; did not meet graduation target; Latino, EL, and SES subgroups did not meet AMO	No - did not meet AMO in math; Latino and EL subgroups did not meet AMO
High School: % of seniors that took SAT	78%	44%	n/a (middle school)

*AMO = Annual Measurable Objectives

Conclusion: Practice over Theory

This chapter examined the programs that defined the teacher preparation pathway for the candidates from this research: Teach STEM as a recruitment program through funding and early exposure to teaching program, STEM Scholars as both funding source and recruitment strategy to augment the pipeline of STEM teachers, and the master's/credential program. These sequential and, at times, overlapping programs can be considered as a kind of hybrid program that, perhaps unintentionally, de-centered the typical approach to teacher preparation of prioritizing theory to inform practice.

The goals and approach to introducing teaching to STEM majors in Teach STEM, such that majors might take an interest in teaching, focused on practices commonly attributed to "*practice-based, practice-focused,* or *practice-centered* teacher education" (Zeichner, 2012, p. 376, italics in original; c.f. Ball & Cohen, 1999). This included a clear focus on teaching practices that are general and those that come form and for particular content areas (c.f. Kazemi, Franke, & Lampert, 2009 for an understanding of this in mathematics instruction). The field experiences were supported by courses designed to support the Teach STEM internships – in terms of content, classroom practices, and guided reflection. However, the program at Cliff maintained a more traditional mode of teaching theory and propositional knowledge to be later applied in field placements. Zeichner, Payne, and Brayko (2014) refer to this as a 'college-recommending program' in which "[c]andidates are supposed to learn what and how to teach in their courses and go out and apply what is

learned in schools during their field experiences" for which there is little evidence of success (p. 2). This application and integration was supported with the traditional integration of a supervisor who observed and supported the candidates in the field and through seminar designed to address this theory to practice process.

For those candidates who entered the credential program at Cliff through the Teach STEM pathway, the merged features and order of offerings across the overlapping programs created a hybrid environment which centered practice and practitioner perspectives. This centering, rather than linking to theory or even producing practitioner-focused theorizing sometimes served to buffer the candidates from the kinds of interventions the credential program offered. Zeichner (2012) argued that, even in practice-focused programs there still needs to be a course "that addresses the historical, social, economic, cultural, and political issues that professional teachers need to understand in relation to their practice and the practice schooling" (p. 380). He proposed a 'place-conscious' approach to such a course so that these larger issues are explored with clinical experiences and coursework. Although Teach Stem was voluntary, the financial compensation for participation and application support were strong incentives for students to join and continue in the program.

Each of the programs (recruitment, support, and preparation) are in conversation with persistent efforts to alter math education. Teach STEM and STEM Scholars responded, in part, to the persistent dearth of qualified math teachers both regionally and nationally and, in doing so, often reinforced perspectives on math

teaching focused on knowing the content and supporting existing classroom practice which was primarily didactic and through a deficit framework on students. These frames of meaning had consequences the ways that the students' teacher identities and practices formed. They formed primarily through this largely unmediated focus on practice in the Teach STEM internships and, later, the candidates' focus on student teacher placements to the exclusion of other course and MA/C program interventions. Practices that worked for recruitment also muted the potential for the MA/C program at Cliff to disrupt long held assumptions of math teaching and learning. The math credential in the MA/C program was designed and enacted with particular attention to shifting away from didactic teaching to the process-based and language rich aspects embedded in recent mathematics curriculum reform which has the potential to disrupt normative patterns of achievement in math.

As will be discussed in the coming chapters, the focus on field-based internships was a useful teacher recruitment strategy. However, without more support for the STEM major to make sense of practice, this led to calcification of narrow views of students in general and math teaching more specifically. The tension between these two programs was difficult to resolve for the candidates who focused on school sites for their own practice and development.

The remainder of this dissertation addresses the candidates as individuals to draw out what was shared and not-shared among them with attention to the limits of this kind of hybridization and recommendations, drawing on the data from these

candidates, for developing and leveraging these programs for critical change in math teacher development and practice.

Chapter Five: Three Candidates

"Student teachers may not necessarily be aware of the historic tensions between conformity and social change, but these tensions are lived during the practice of teaching" (Britzman, p. 73).

In this chapter, I introduce the teacher candidates in more detail and provide an analysis and discussion of the relationship between their histories as math learners, their experiences with the Teach STEM and the STEM Scholars programs, and their decision to pursue math teaching as a career.

Pierce overview

Pierce, a White male, was twenty-two years old at the beginning of the study. He is a case of a math teacher who came to the profession as a previously casual and self-described lazy math learner. He had an affinity for the subject but did not strongly identify as a math person. As a teacher he anticipated a similar orientation from his students and operates from an assumption that he – as the teacher – must motivate student engagement. He does not foreground a presumption of student motivation and interest in the subject math as prerequisite for math learning. This perspective was bolstered by perspectives shaped from his heterogeneous friend group in high school; by contrasting their experiences, he came to understand his academic track (with more academically challenging coursework and what he perceived as 'better' teachers) as atypical given the norms in his high school.

He described his family as both well-educated and financially insecure and it was from this vantage point, given the relative stability of the profession and financial

incentives to start, that he was initially drawn to teaching. Once involved with Teach STEM, he found that the work of teaching and complexities of student learning made the career a good fit for him. An ongoing tension in his work was reconciling the ease of transmission approaches to teaching with his preferred process- and collaborative approaches. He found that he was a great fit for his school site which supported his development of these more complex approaches to math instruction and allowed for collaboration across disciplines such that teachers could see parallels and connections across subject areas but also could view students more holistically as they also collaborated on student support and whole-school revisions to policies such as homework and academic support.

Pierce in many ways exemplifies the broad hopes of current recruitment efforts – to draw someone with subject matter mastery to teaching middle school math who (1) had not considered the profession prior to recruitment efforts, (2) was supported to complete both the major and credential plus master's degree, and (3) remained teaching in a high need setting. Even more importantly, he endeavored to do to so in ways that disrupts the traditional norms of math teaching which reify deficit assumptions about students, often from a didactic and control-oriented teaching focus.

History as a math learner and experiences of math teaching.

Pierce grew up attending diverse public schools in a largely middle class and racially diverse city outside of Los Angeles. As a student, he felt like he was pushed to perform more in math and science than in other areas, such as English or history. Math came easily to Pierce and he was drawn to the path of least resistance. In his

case, the easy path led to advanced math classes taught by exceptional teachers who framed the ability to teach others as the ultimate demonstration of content mastery.

Although a conscientious student who completed his assignments on time, he also acknowledged doing the 'bare minimum' to get by. He said, "*I read the system very well and since I could memorize facts and information rather than having to think in many classes, I passed many with ease*" (int 1). He performed well in school and found that his position in academically advanced classes gave him access to better teachers as compared to his peers. "*Since I was in like those higher class, the AP classes, uh, I guess I had what I thought were really good teachers because they did more with us than like I heard my friends talking about in the 'regular' classes*" (int 1). Although critical of his experience, Pierce felt that others had it worse.

Pierce privileged classes that were more process- and discussion-based over those that emphasized rules, routines, and memorizing discrete facts; he preferred teachers that demonstrated their care openly as evidenced by checking in about his progress and discussing topics of mutual interest. These preferences guided much of his focus as a prospective and beginning teacher.

Regarding math, specifically, he said that in the fourth grade he was "pushed" into a higher-level math class working on fifth grade content. From that point on, he was consistently tracked into higher level math classes and found that this gave him "a big boost" when he had to settle on a major and career because he knew was good at math. He attributed his interest in math to his ease with learning math concepts

which was reinforced by positive feedback by teachers and peers. So, ease with the subject became a reason to continue in it.

In school, Pierce found that he often helped other students. Referring to his Geometry teacher, who stood out to him as different from his other high school math teachers, he said "*if we understood it, he'd rather us not even take a test. He wanted us to help everyone else and then later on I learned that like social learning stuff*" (Int 1). From these high school classes, Pierce came to think of teaching as a way to demonstrate content mastery. In retrospect, he understood that this was not merely an assessment strategy but more so a pedagogical approach – what he termed "social learning" – which prioritized collaborative learning.

From math student to math teacher.

Pierce began as a freshman at Cliff University with a declared major in Environmental Studies but found the integrated program difficult to navigate. He changed to the one department math major and chose the math track for future educators. This was the less challenging path through the major and that appealed to him, even though he did not initially intend to pursue teaching[8]. He also enjoyed the smaller size of the major and ready access to advisors as compared to the integrated program he started with.

He learned about Teach STEM from a friend in the math major. While connections to peers and financial incentives were significant in bringing him to

[8] Just prior to the start of the study he was deciding between a teaching credential program and an internship in video game design.

Teach STEM, over time Pierce became increasingly interested in the process of student learning. He focused his efforts on the internships and courses on sociocultural theories of learning. "*I liked [those courses] because we looked at how students thought, their thought processes. And that interested me even more [than math]"* (int 1). He described being more interested in these courses than those for the math major.

Pierce participated in Teach STEM for the two years prior to entering the MA/C program and completed three quarter-long field experiences. One field experience was at a local high-performing high school in an Algebra Two class; the other two placements were in diverse middle schools, one in a sixth-grade general math class and the other was 7th and 8th grade pre-Algebra. Although the field experience felt 'daunting' to begin with, it helped Pierce develop ease with the work of teaching, a sense of pride in teaching concepts that were difficult for some students to grasp, and he enjoyed the satisfaction of watching students perform well and increase their confidence. Through Teach STEM he learned classroom management practices needed for successful teaching (e.g. hand signals to focus the class), informal assessment procedures (e.g. quick checks for understanding), and ways to support students with difficult behaviors.

Pierce was interested in developing a more open, inquiry and process-based math teaching practice. However, as an undergraduate visitor to middle and high school classrooms, he found it easier to participate in classes with more traditional modes of math instruction. Even though at odds with his own pedagogical interests,

these classrooms mirrored many of the classrooms he experienced as a student and there was a certain ease in that.

> *Certain teachers made it easier because I walked into the classroom and they already had the routine and I got used to the routine and then I thought ok I could teach the warm up, or, oh, we'll plan a lesson for this day. But, the teacher that had that routine also didn't have much variation. It was homework, warm up, check homework, lesson plan, start homework in class and then they were out. There's no like closure, I think, at the end of the lesson.*

This was a tension Pierce experienced over the course of the study – the ease and familiarity of didactic, teaching as transmission approaches contrasted to his interest in more process-based approaches.

Reasons for Selecting Math Teaching.

Pierce was drawn to teaching for its promise of occupational stability and was encouraged by the financial entry incentives he gained access to through Cliff University. *"Jobs for math teachers right now are really stable and your loans get forgiven. So, it was kind of a big plus in our family because of a tight money situation" (int. 1).*[9] His indirect path into the math major seemed to give him a unique lens to approach his own learning about teaching. His narrative of early competence in math positioned him as a fit for the work, but his interest in teaching mathematics

[9] Here, he is referring to the STEM Scholars program, the relative job security for math teachers given the chronic shortage, and loan forgiveness programs such as APLE (Assumption Program of Loans for Education). At the outset of the study, he planned teach for at least the four years required to reduce his student loan debt.

arose from his abiding interest in how people learn and his delight in being able to bring complex math concepts to all kinds of learners.

His experiences as a K-12 student caused him to be critical of closed-ended transmission approaches and he came to favor more open-ended and process-based approaches, despite the ease with traditional modes of instruction that were familiar to him. Teach STEM also afforded him opportunities to engage struggling students one-on-one with these approaches. Referencing a particular example with a struggling student, Pierce said:

> *He was doing a problem and was like 'I don't know what to do' and I asked him 'what do you think you need to do? What are we trying to find?' and he's like 'Ohhhhh!!!' and then he was dividing and was like 'those numbers are too big for me to divide' and I tried to think of ways to help him see we are not dividing a huge number and a small number, we're dividing small numbers. But when he finally understood long division, I was pretty happy. And it felt satisfying I guess… and he got a 100% on his test and that was the better part for me (int. 1).*

Those early experiences were ones that he would return to – the value of working closely with students to help them understand content and improve. He also found that the experience in Teach STEM gave him a unique perspective on teachers' work. *"My experience in the classroom in Teach STEM introduced me to the classroom from a teacher's perspective and have loved it ever since*" (int 3).

Student Teaching.

During the MA/C program Pierce prioritized field experiences over university coursework. He felt that it was where he learned the most. *"All the theories and everything, like, the experience is what I think makes a better teacher."* Despite his

enduring interest in sociocultural theories of learning which were addressed across the MA/C program, he prioritized time spent in classrooms. This sense that experience supersedes course learning was an approach he described learning in Teach STEM.

While he appreciated that the MA/C program privileged pedagogical approaches that stemmed from sociocultural and critical theories of learning, he was also critical that a broader range of approaches were not presented.

> *We're just kind of told these things and I accept them because I can see how they benefit the students but then other times we are told some ideas are bad and they just don't give great reasons why. They say this theory is better and it's just a way for the students to do group work and cooperative learning. It works, they do the work. But it doesn't seem to take into account that there's a lot going on for our students" (int 3).*

He felt that they were asked to accept what was offered somewhat uncritically. He contrasted this close-ended approach to teacher learning with the more open-ended pedagogical approach they were asked to use with middle and high school students. Recalling a student-led discussion about behavioral approaches to teaching, the faculty member responded *"'well, let's think about that again' and you're like, so that means I'm wrong"* (int 3). While the program's focus was resonant for him, he wanted more space to understand and contrast perspectives on math teaching. In part, his interest in exploring these differences was fueled by a desire to respond to dominant teaching as transmission approaches he found in one of his cooperating teacher's classrooms. This contradiction between his own interests and the perspectives advance by the MA/C program on one side – and some of the more

didactic modes he experienced across field experiences on the other – is one that persisted over the years of the study.

In his longer student teaching placement, at xxx Middle School, Pierce had two cooperating teachers. One CT exemplified the collaborative, process-focused instructional approaches that felt resonant for him. This teacher took the opportunity of having Pierce in her classroom to inquire more deeply into her own teaching and, through their collaboration, both seemed to develop better relationships with students and, over time, both shifted practices. Theirs was a collaborative working relationship and Pierce felt well-supported to take risks as a teacher.

The other CT, who taught the same grade and content, could be easily represented as exemplifying the very practices that Pierce wanted to move away from. Her instruction came from a didactic, transmission-based approach with heavy-handed control over students including management strategies that focused on strict behavioral norms where students could not move their bodies, she yelled at them when deducting points did not work and, at times, publicized poor grades. Pierce attempted to follow her instruction but struggled with it. When he took over the class, Pierce worked on shifting the norms in the class but this did not come easily. This CT came in the classroom often while he was teaching and would interrupt instruction regularly. He was constantly walking a fine line between replicating and resisting the norms in place.

On one occasion when the math teachers were off site for the day for professional development, he and this CT received reports that the students had been

very challenging and rude with their substitute teacher. She was enraged and anticipated the Pierce would harshly discipline the students. He said, "*I was kind of shaky. What am I going to do? It's like I'm really mad at them but I can't, no I'm not going to yell at them and make them feel really crappy*" (int. 3). He led a full class discussion about the substitute experience and asked each student to write a letter of apology. He tried to find a place of accountability that would not invoke shame. This was a critical moment; from that point on, his practice in that class slowly shifted away from the set norms to be more on par with what he did in the other CT's math class.

Math Teaching.

For the seven years since Pierce completed his math credential at Cliff, he has been a math teacher at Alta Middle School in the same town as Cliff. This is one of the schools where he completed an internship for Teach STEM. He concluded early on that a process-based inquiry approach to learning in a more or less democratic (versus top-down hierarchy) classroom was what he strove to develop in his own teaching. It seemed to him that teaching middle school math would be his ideal job. He saw his work as a middle school math teacher as *"not just focusing on the content area. I need to focus on the students, on their lives, and how I can help them effectively" (int 1).*

Starting with his Teach STEM internship and also evidenced in the job interview, he enjoyed his colleague's kindness and that their pedagogical approaches aligned with his and those prioritized in the MA/C program. "*They were extremely*

nice. And they asked questions that kind of meshed with the program, with the grad school program" (int 4)[10]. Taking a position there essentially extended his relationship with CTs from his longer placement at Highland Middle School. Within the same district and with similar curriculum initiatives, they continued to plan, share assessments, student data, and professional opportunities.

Pierce was immediately regarded as good teacher, often receiving feedback that he did not "***seem like a first-year teacher***." His induction mentor was among these. "*Since he doesn't see me as a first-year, he's not as worried about me, or as involved in what I'm doing as he would another teacher who's maybe drowning at another school a little bit. So, I feel like I'm floating along nicely*." He was quickly afforded the kind of autonomy that might be more typical for someone further along their career.

Partly due to this autonomy, Pierce could determine where to put his professional development efforts. This was a good fit for him who priorities aligned well with the school. He focused on collaboration with other teachers across content areas and continued his focus on process-based learning. Of his own schooling, Pierce said "*we were just told what to do, how to do it, but not why"* (int 2). One of his goals as a teacher was to present alternatives to students so it's not just getting it done but they understand why.

[10]Here he is referring to finding a fit between the perspectives from the MA/C program which he largely adopted as his own and those at the school site.

Although he struggled at the outset to find enough hands-on activities and worried about his competence in addressing language arts concerns within math such as comprehension and sentence structure, he found his strength in teaching students to develop critical thinking.

Pierce built strong relationships with students as he understood a significant aspect of teachers' work as engaging and motivating students to learn.

> *If they like you, then you already have that respect level. And if you tell them something, they know that you're the authority on that. And they go with it. If they don't respect you, or if you're not friends with them or if you can't connect with them in some way, then there's no reason for them to hold onto that information or to believe you or care about it (interview 5).*

For Pierce, good math learners were those who try, they show up for help when they need it, and ask questions. He did not pose a subject-specific orientation for students but, more so, a willingness to learn. "*They don't have to be interested in the material, but they're ready. So, if you're talking they try to listen to you… or they come in to ask for extra help" (int 3).* He wanted them to ask questions so he could target his support. "*If they don't ask questions, I don't know what they need to know, what was unclear for them"* (interview 2). This approach emphasized skills students can develop to do well in school overall, but he did not seem to exclude various kinds of learners; he understood teachers' responsibilities in scaffolding for students. "*Some students process orally. You need to talk to them. You have to say, 'so tell me how you do this and they can tell me that, I don't really care that much if they did it on a test" (int. 3).*

By the end of his first year, Pierce's optimism and sense of success in teaching was palpable. His students were happy with his efforts. He felt connected to staff, administrators, and other teachers – as well as former mentors in other local schools. Recognized as competent, he was given space to build lessons and not follow a structured program, so he implemented ideas from the MA/C program. This included lesson plans from his supervisor, a focus on backwards design, and cooperative learning. He spent time understanding differentiation. What seemed like an unreachable goal as a teacher candidate became clearer as a teacher.

> *[My supervisor] kept talking about it, like hey, you have to change it for every student. And I'm like 'that's impossible. How do you do that'? what she couldn't teach us is that being in the classroom with certain students, you have to do certain things differently. But it's only—the only thing you have to change is the way you say one little thing to one student. Or you let one student use a calculator, then they feel comfortable. (int 5)*

That he felt comfort with colleagues and received clear support for his own development were critical to his growth and sense of fit at Alta. He felt his professional learning was well-supported by his school with regular meetings, funding and support for professional development, as well as time to observe other teachers. Pierce enjoyed the warm and inclusive culture among teachers, administrators, and staff at Alta MS.

> *I know I said community a bunch, but here, I really feel supported by the other math teachers right now, and even some of the other core teachers, I asked to observe a core teacher. She's like come on in. I want to observe her class to see my other students—I want to see my students in another class.*

Referring to his school administration, he said *"if you want to, I guess, learn more about teaching, they're always willing to help you*" (int 5). Being in his own

classroom with access to new kinds of professional development from an interdisciplinary perspective, Pierce tried many approaches. "*I'm applying everything I run into, even if I don't agree with it".* This included grading practices where students got full credit for submitting homework even when it was incomplete or late.

Over time, his perspective on good math teaching drew some parallels with his hope for students, as a kind of willingness to try.

> *Being a good teacher is just being willing to apply something that you haven't done before or figuring out what works. I've been adapting on the fly, like really fast. Like, if something's not working, I've learned to change (int 5)*.

It also came to more explicitly including caring practices, boundaries, and planning ahead. He recognized that his teaching practice extended beyond the classroom and began to both understand, and was at times overwhelmed by, the extent of communicating he had to do. "*That's all school is, is communicating with each other"* (int 5).

Summary.

Pierce is the case of someone who fit the current hopes for recruitment efforts – someone with a strong math background who, initially, did not consider teaching as a career. Drawn in by job stability and financial incentives, he quickly learned that he loved the work of teaching. He chose to teach in a high need middle school and privileged approaches to teaching math that align well with current reforms.

Drawing on his own experiences as sometimes 'lazy' student and contrasting that with peers' educational experiences from middle and high school, he understood

his role in engaging, motivating, and supporting students to learn. His hope that they 'try' allowed for a range of learners to find a place in his class.

Pierce highlighted good math teachers as those who teach for understanding over memorization with a focus on math as a literacy, they have a commitment to their own ongoing learning and develop good relationships with their students. Good teachers were those who developed good relationships with their students, in part, to encourage the students to participate.

Carmen Overview

Carmen, a Latinx women, was twenty-two years old at the start of this study. She and her siblings were the first in their family to attend college. Her determination to succeed academically and professionally often led her to prioritizing individual effort over socializing as a high school student and beyond. This often led her to isolate from others to study and complete work. When she transitioned to college, Carmen had to adapt to new ways of learning to stay afloat. While her study habits shifted, her approach of self-seclusion did not. Her involvement in Teach STEM was also self-directed; she rebuffed the social aspects of the program and focused on leveraging her program experiences for short term employment opportunities and to support her admission to the credential program. Her highly individual approach conflicted with the collaborative focus of teacher learning addressed in the MA/C program.

While critical of her own education marked by didactic teaching, she struggled at first to redress these concerns with different approaches to teaching herself. Initial disruptions in student teaching and tensions around her cooperating teachers' control orientation caused her to refocus efforts but did not lead to changes in practice. She discerned that a fundamental part of her work would have to do with creating a welcoming atmosphere for immigrant students in particular and to develop mathematical literacy in both Spanish and English.

However, Carmen's desire to please the CT and get hired at the school site meant that she privileged control and didactic teaching as a student teacher.

History as a math learner and experiences of math teaching.

As a K-12 student, Carmen attended diverse public schools in a small racially and socioeconomically heterogeneous city in the Bay Area. Overall, she described herself as a model student.

> *In elementary school, I was always the good student. The student they liked. They could always depend on me for getting my work done. Pretty much the teacher's pet. And then in junior and senior high school it varied, I was never great at language arts or English. I was never the favorite students for those teachers but for the other ones I was… I was always the student who got by without ever really having to raise their hand or ask for help. I never spoke up, but I was still able to get the 'A'" (Carmen, Interview 1).*

With this positive framing and self-description, she not only described aspects of herself as a student but also privileged certain aspects of being a student – completing work, endearing oneself to teachers for positive regard, and perhaps most interestingly (and something that she returns to again over time) she draws a line between not only earning a high grade ("the A") but not requiring help to do so. "*I never spoke up but I was still able to get the 'A'"* (Carmen, Interview 1). Carmen described herself as someone who focused on schoolwork to the exclusion of other social activities.

> *High school wasn't that great. I was more about going to school and doing good then I was like whatever else… for lunch and brunch a lot of times I found myself going to the library to finish homework* (Carmen, Interview 1).

In this conception of teaching and learning, teachers deliver instruction and students earn good grades; the relationship between these was vague and relied mostly on earnest students, like herself, who focused on academic work to the exclusion of other school or social events.

Regarding math specifically, Carmen realized that she excelled in math as compared to her peers in middle school. "*I think it was in the sixth grade that I noticed that I was finishing a lot of my math work really fast. First, I would do the math homework and then I would do everything else*" (Carmen, Interview 1). In this description, again, she comes back to one of the indicators of being a good student as work completion. She remarked, "*I was just really good at [math] and it just always comes easy to me and it's interesting*" (Carmen, Interview 1). She initially described her math teachers in particular to be "really nice and really approachable" (int 1). However, by the start of the MA/C program, she was critical of those same teachers. Reflecting on her educational experience, she wondered why they did not attempt to engage with her more deeply, support her to speak up, or to learn beyond memorizing and repeating facts. At the start of her credential year, she lamented their approach.

> *Even now I wish that some of my teachers had pushed me to speak out, think for myself. I learned a lot of memorization, never really having to think critically. And then you come to college and it's completely different. Why didn't my teachers ever help me?*" (Carmen, Interview 1).

Although she excelled academically, she did not feel that she had many good teachers in high school, especially not in subject areas other than math.

The challenge here was both that of access to the kinds of teachers she imagined and a conflict in perspectives about what success as a student could be. Her enduring sense of being a good student, a point that I will take up again later, mirrored her own experiences. They were students like her who earn good grades, endear themselves to teachers, focus on academics over other activities, and do not require much attention. However, these traits were in conflict with her expanded

sense of what learning and schooling could be which, consequently, would shift what teachers do. So, if learning is less memorization and more process-based or shared negotiations, teaching would necessarily require a higher level of engagement and a different kind of instruction that is more interactive and teachers who expect a marker of success beyond test scores from students. In the years of this study, this is a conflict that was not resolved. As she moved into student teaching and then became a teacher herself, Carmen privileged the students that were similar to herself as a K-12 student and initially adopted practices similar to those teachers she came to critique.

From math student to math teacher.

Carmen's selection of a college for her bachelor's degree was an intentional one – she sought a college where she could major in math, minor in dance, and would receive the most financial support. She found all of these at Cliff and, once there, she chose the mathematics and education track. With experience teaching math to siblings and dance to children during high school, she was confident in her career direction as a future math teacher.

Once a student at Cliff, Carmen encountered academic challenges. It was this point that caused her to reevaluate her own educational experiences, even before taking classes on education specifically. She came to understand that, although academically successful in high school, she was not well-prepared for the rigors of college. That she could be seen as academically successful in one context and struggling in another became an important moment of self-definition. Rather than

giving up on the math major, Carmen dug in. Similar to high school, Carmen excluded herself socially to complete her work.

> *I've always been like self-motivated to do good. If I'm gonna major in it, I'm gonna major in it. I'm not gonna give up... You know math always came easy for me and I was never used to like studying for math. So, it was kind of like one of those things. I had to learn to study in college* (int. 1)

Her peripheral location and revised study efforts helped Carmen complete coursework at Cliff. Her shifted study habits and critiques of her own high school education did not, however, shift her general approach.

Carmen learned about Teach STEM through the university. A letter was emailed to all qualified students and she applied for it in her Junior year. Unlike the others who were brought in by peers or referred by professors, Carmen's entrance to Teach STEM was self-directed. She intended to use her experience to support her application to a credential program. In discussions about the affordances of Teach STEM, Carmen highlighted the ways she leveraged her experiences for personal and career goals and she felt that participation in Teach STEM confirmed her career choice. "*It put me back in the classroom... after two years of being with college students and away from what you want to do it gets you further and further away from what you want to do. And then Teach STEM kind of brings you back*" (int 1). She enjoyed the internships specifically was able to use her experience in Teach STEM to apply for a paid position as an instructional aide for migrant students in a local high school. Her focus was more on the notion of being a cultural math with and linguistic resource for students than subject- or pedagogically-specific approaches.

This was confirmed for her by the presence of other Latinx teachers in the high school math departments for Teach STEM internships.

She participated in Teach STEM for two years and completed three quarter-long field experiences. Two of these were in middle schools and one was in high school. Carmen also completed the Education minor and appreciated the program's explicit focus on teaching diverse populations. It was here that she solidified a conception of herself as teaching in predominantly Latinx and Spanish-speaking populations.

Reasons for selecting math teaching.

Carmen was drawn to teaching math because of her own sense of ease with and love of the subject. "*I want other students to love it as much as I do but I think a lot of students don't.*" At times, her interest in teaching extended beyond the subject area and focused on student motivation. She was conflicted about this aspect of teacher's work but understood it to be important. She anticipated struggling with students who did not appear motivated, but also felt that getting students to learn was a significant aspect of teaching. "*I want them to learn. It's not so much math anymore, but I just want them to be motivated. As long as that's the issue, they don't care and don't see the big picture"* (int 2). So, addressing her love of math generally and building students' motivation to learn, more specifically, were reasons to pursue teaching. She also felt it was a good fit for the life she imagined. Preparing to marry and start a family shortly after completing her credential, she felt a teaching work schedule aligned with a family life.

She initially chose the MA/C program at Cliff because of the inclusion of a master's degree in the year long process and the explicit focus on preparing teachers for diverse populations. The location was also a consideration as her fiancée was employed in the region.

> *I like that you could get your master's too and in one year. Also I liked the fact that it was about diversity. I had taken classes about diversity and then did the education minor and I really liked those classes and so I was looking forward to it* (int 1).

When Carmen transitioned from undergrad to the MA/C program, she went from a structure that, like her high school, prioritized individual achievements to one that privileged collaboration. Although some of her math professors disrupted this with a focus on collaborative grouping, success in most courses in the math major was ultimately a matter of demonstrating content mastery through assessments, typically tests. In contrast, the MA/C program grouped candidates in courses by cohort and collaborative work was a key feature in the program.

Carmen, who was often reserved in class settings, struggled to find ways to participate. In the math cohort, specifically, Carmen felt like an outsider. In the cohort of ten, eight completed the math major at Cliff; of those eight, she was the only one who was consistently outside of the group. In interviews, all of the candidates noted this dynamic. During the first few months of the MA/C program, Carmen wondered how to participate in the group and ultimately chose to maintain her distance. "*It's like a secret society. How do I break into the seven and do I really want to? It's a clique and it's kind of hard to think about getting in there. I see that I'm not really a part of it, I just go there to learn*" (int 2).

What she framed as a reason to attend Cliff– the focus on diversity – came with some specific challenges for Carmen. As the only student of color in the math and science cohort and only one of two in the broader single subject program, she often felt either intentionally isolated or singled out. The initial summer in the MA/C began with a course that attended specifically to concerns about race and Carmen began to notice that, in contrast to the more diverse undergraduate courses in education, she was often the only person of color in the room.

> *It was the first time I was like, hmmm, are there any other colored students in the program…You look for people of your own race to connect with even though sometimes you connect better with other people obviously. But I was looking and didn't really see anybody* (int 1)

Along with this sense of isolation came an awareness that her peers anticipated that she would address the issues raised, to speak on behalf of students of color.

> *I don't know if it's me or if I'm overthinking things or something but sometimes we'll be talking and I'll feel like maybe other people are expecting me to say something because I'm the minority… like when we are talking about minorities, I feel pressure to say something* (int 1).

As noted, Carmen's tendency toward self-exclusion and valorization of individual effort came into uneasy contact with a social and pedagogical focus on collaboration. This was further complicated by the racial isolation and racialized exhaustion she felt from being often the only student of color in her classes in a program that held as its focus preparing teachers to teach students of color. She was often, then, not only a participant but an object of intense inquiry and not prepared to take a role in educating her peers.

Student teaching.

Over time, Carmen came to attend almost exclusively to her cooperating teachers' advice, even when it was at odds with who she hoped to be as a teacher and the guidance by the MA/C program. This was especially true for her second, longer, placement at Zuniga high school. As she began this placement, she was concerned with the level of control and strict behavioral guidelines enacted by her cooperating teacher, Vero. Students were regularly removed from class for minor infractions. This control extended to Vero's relationship with Carmen who she noted "*has a way of kind of putting you down and talking down to you… I've gotten used to it but at first I felt like I couldn't do anything right.*" (int 2). When Carmen was teaching, Vero would interrupt, correct, and take over lessons if she did not approve. Some of the students shared concerns about this, notably a group of English learners that she worked closely who Carmen shared "*told their ELD teacher that the felt bad for me because of the way she treated me*" (int 2).

When Carmen transitioned to solo teaching, where the candidate takes over primary teaching responsibility for one period, she found that she also began to enact very strict procedures and blamed the students for her inability to be happy as a teacher. "*I am constantly trying to be happy but then the students get me mad and I get frustrated because I know they can do better*" (int 2). Here she is referring to both their behavior which she found required constant modification and their level of effort in math. Reviewing videos of herself from the state required teacher performance assessment, she confirmed her flat and even stern affect with students. "*I really just*

have to have fun… especially when I saw videos of myself! I realized that I am serious in front of the classroom… I have to take it up a notch. I really have to laugh or something" (int 3).

Carmen solicited student feedback to reset the class and they shared that she was less nice than when she was the student teacher in the room. To address this, she attempted some group-focused activities, similar to those taught at Cliff. "*I try to think of group activities like they do at Cliff because the students really want to interact*" (int 2). These interventions were short-lived as they did not meet her CT's approval. Ultimately, she focused almost exclusively on Vero's model in hopes that she could be employed at Zuniga. "*With lessons that I plan, I have to think 'will Vero like this?' because, well, I'm getting a job soon and I'm actually thinking about applying to Zuniga so she would be like my main ticket in, so I have to please her, you know. Honestly, I'm trying to get on her good side*" (int 2).

Carmen's desire to teach diverse learners focused on what was common between her and them – linguistic, social, and cultural background, SES and familial level of education, match in school experiences, and similar approaches to being a student. However, as she anticipated, supporting students who did not appear motivated was a struggle. "*I know there's a lot of students who need support and that person that's not giving up on them and I think that's hard for me to not give up on students*" (int 3). This movement away from students who struggled and did not self-motivate continued as she transitioned from student teacher to instructor of record.

Math teaching.

Over the seven years following the completion of the MA/C program, Carmen taught at two schools in the area surrounding Cliff. She taught in a middle school for one year; when her position was not funded for her second year, Carmen applied to and was hired at Zuniga, the same high school where she completed her longer student teaching placement.

She accepted her first position because they were among the first to offer her a position and was closer to home than her other offer which was a charter in a larger city. They wanted a bilingual teacher and that was a draw for her as well. Once there, Carmen learned that she was the only teacher of color and she wanted to be a role model for other students of color, specifically Latinx Spanish speakers which comprised a large proportion of the school's population. She began with a strong interest in teaching English Learners (EL), who she described this way:

> I think that a lot of the English learners are actually the best students. They do their homework, which obviously we like, and they'll pay attention you know, and do their work… it's probably because wherever they came from they were taught to respect their teachers and education (int 2).

Carmen soon found that the students she prioritized were just a small subset of the school's EL population. As the only teacher instructing all four sections of the remedial 'algebra readiness' course, she encountered students who were also disinterested and disengaged. Teaching a course without a defined curriculum to many of the school's students who struggled in math was a kind of disruption in her plan that brought her to another decision point. Carmen's sense of herself as role model and pride in being the only teacher of color at the school shifted into anger

with students who did not complete their homework or were not academically success. Similar to earlier struggles with her math major, she chose a focus and dug in. Following her longer-term CT, Vero, that focus was a stricter discipline and penalty system.

> *And then, it started like slowly like slipping away, and I felt like I was losing control. So, it started off good, and then it started going downhill. And then, I started losing my patience. It went—I think it went uphill a little bit when I decided that I needed to do something, and so I went to Borders and I bought a book on classroom control. And I started changing some things up. I think that's helped a lot.*

She continued this focus and reported that it shifted over time.

By the end of her first year, she looked forward to those classes with students she felt connected to and completed their work. "*I look forward to the classes that I feel comfortable in – the students do their work, or I don't have to get mad and tell them to get back to work* (int 5). She lamented her assignment for remedial courses, particularly at the end-of-year awards celebration.

> *It would've been nice to have some high kids. Because it's like at the end of the year, when they were picking all these eighth grade awards, and it's like all these students that I don't know. I had one student and it was kind of sad….So, having a high class, you know, to at least feel good about some good students, but I had like all, you know, like all the low kids that are like in algebra readiness for a reason. Because they never do their work. Or they're like—they have such low math skills, and it's like really hard.*

Carmen's hope was that her work as a teacher could be externally rewarded by having students publicly acknowledged for their high grades.

While she described the math department as highly collaborative, her primary teaching assignment (algebra readiness for four of her five periods) was essentially a

solitary one as she was the only teacher with that course. Without a defined curriculum and colleagues to collaborate with, in her first year of teaching she had the challenge to create the class from scratch. She recognized her role as someone learning to teach math and focused on what she felt would compel the students (discipline), many who struggled with math, rather than specific strategies that might augment engagement. Again, her pedagogical approach relied on teaching EL students that she narrowly defined as mirroring her younger student self; absent that, she focused on control.

For her second year of teaching, supported by her CT, Carmen returned to Zuniga where she completed her longer student teaching placement just a year prior and. As of the completion of this dissertation, she is still there. Her primary interest was in returning to a predominantly Latinx school and community.

I like being able to help that specific population… the community is 90 percent Hispanic, and so I thought as a person coming from a low-income, Hispanic, background, you know, with parents are also bilingual parents that will have very little education, I just felt like I could really connect with the students here, and also help them, you know, share my background(int 4)

When she returned to Zuniga there were some changes both to her sense of herself as a teacher, as well as in the school in general and the math department more specifically.

Transitioning from middle to high school felt like a better fit for Carmen. Although she had some struggling students, she now taught students with a more diverse range of aptitudes and working habits. "*It's different, which I've definitely*

enjoyed more. In the geometry and algebra II classes, I have some of the kids who are more advanced, and who actually like taking math. So it's nice having that positive energy in the classes" (int 5).

Zuniga is a site with high teacher and administrator turnover. During the year since she was a student teacher, there was a new administration and mostly new math department comprised more so of younger Latinx women with whom she felt at ease. She found a peer with whom to collaborate and focused her professional learning in that pairing.

> *Well, it's kind of split in two. It's like these older teachers that have this different view on teaching, it's kind of like an older classic view, and then these newer teachers are more interested in really getting the students engaged, and definitely at a younger level. And yeah, I really felt like, I've been able to— Find people* (int 5).

Carmen had limited contact with teachers in other departments and described rarely interacting with the school's administration. Although she seemed to maintain a focus on strict discipline and prioritized students whose approach to learning was similar to her own, there was a sense post-induction, that she returned to some of the ideas from the MA/C program some of which she inserted somewhat inconsistently and surreptitiously as they were they were not the preferred modes of instruction. "*I'll find materials—I'll find some online, make them up on my own. I've used IMP—[whispers] even though we're not supposed to" (int 5)*. Over time, she found herself enjoying the work more and more. Part of it was her sense of fit with the community, the age of the students, and, ultimately, more ease with the work of teaching. By her

fifth year teaching, Carmen was consider 'mid-career' as compared to her math department peers and had more control over which courses she taught and was mentoring student teachers from Cliff as well.

> *I could be more strict with these high schoolers, and talk real—almost adult-to-adult kind of conversation… And so now that I'm in my fifth year teaching, like, I wake up, and I'm excited to go to work. Maybe it's because I don't have any crazy students this year that have given me attitude or behavior problems, or maybe it's because I've become a better teacher, I don't know what it is. Something's different and I enjoy my job a lot more this year than—like, every year, it gets better. You think about those things that are in your first couple of years, like, oh my gosh, what will I do? And then it comes naturally.*

Summary.

Carmen is the case of someone who was able to leverage recruitment efforts to support her anticipated career as a math teacher. Her interest in teaching other Latinx students in low SES settings was bolstered through coursework in Cliff's education courses as an undergraduate with explicit attention to need more teachers who are both a cultural and linguistic match to students. Seeing herself as academically successful and only minimally critiquing her own teachers who favored didactic and transmission approaches to teaching, her desire to teach other Latinx students was not accompanied by an understanding of the intersections of education and social change. She tended to favor students who were like her – quiet, hard working, and academically successful. This was especially true as a student teacher where her focus was most often on pleasing her cooperating teaching. Given her CT's strict and highly routinized approach to teaching, there was little opportunity for Carmen to develop differently.

Tanya Overview

Tanya, a White female, was twenty-one years old at the beginning of the study. She described her upbringing as upper-middle class with a working-class mentality due to her father's experience of coming from a 'really poor family.' She came to the profession through participation in Teach STEM after a professor, for whom she was a Calculus teaching assistant, referred her to the program. She excelled in school across subject areas and particularly enjoyed math from a young age. She found that she often tutored others in math and came to associate teaching math as a way demonstrate subject matter knowledge but also came to define good teaching, for herself, as explaining.

Her years as a K-12 student were marked by strong relationships with teachers and she maintained the same group of friends through middle and high school and beyond – all of whom were academically advanced. By her own report, she 'worked well' in the school system. She described good teachers as fun and anticipated that they would exceed the traditional work of teaching by bringing in engaging activities, both related to the content and not, and would see students outside of class for extra study sessions and fun, social events.

Through her participation in Teach STEM internships, she developed an interest in teaching for social change. She chose predominantly Latinx and low-income sites for student teaching and, despite her evolving interests in the potential teaching for social change, her perspectives on the students and sites shifted quickly towards deficit understandings of the students which led to more control-oriented approaches

to classroom management and, mostly, transmission approaches to teaching. She reinterpreted what she valued in her own teachers as context specific when these deficit framings led her to believe that students in the predominantly Latinx sites 'needed' harsher discipline and more rote approaches to teaching.

After completing her credential, Tanya taught for five years: two years in a school site with similar demographics to those where she completed student teaching, in Hawaii for two years, and then out-of-country for one year.

History as a math learner and experiences of math teaching before Cliff.

Tanya was born in Colorado and attended a Waldorf elementary school there, then moved to a small rural town in Northern California in the fourth grade where she attended the local public school. Her family later moved to a nearby mid-sized town when she began middle school. She characterized her middle and high schools as being most White, middle- and upper-class students.

About her experience as a student, Tanya said, "*I was always a very good student. My teachers always liked me, and I always got really good grades. I worked well in the school system*" (int. 1). For her, good grades meant receiving straight A's across all subject areas consistently from elementary through high school. She had the same group of friends from middle school through college. She described her friend group as similarly successful in school, and those who consistently got along well with their teachers and completed their work without prompting. Her relationships with teachers occurred outside of school also. Many were family friends and she described having dinners and spending holidays with some of them. She

found these close personal connections allowed her to get to know her teachers and she felt this gave her a certain comfort at school. She felt the teachers with whom she was close pushed her harder than others and felt this was an important aspect of teaching, to make it a bit more challenging. "*If school is just easy, it's like boring*" (int 2). Through these experiences, she felt that good teachers develop those relationships and are generally well-liked by students.

She referenced her high school physics teacher as an exemplar of the kind of teacher she hoped to become – someone who knows their content well and also makes the class fun and engaging, in ways that both do and do not relate to course content.

> *My teacher would bring in these experiments. And he was this funny little guy and he would play like oldies music and he would make it really fun. He would do these like spin these little tops, you know, and he'd be like so excited about it…. And he would help us all like study for the AP test, like every morning before school for the month before he would … Yea. We could get to school an hour early and study with him and then he had a study session at his house where he made us all food and the whole class got to go and stuff. He was just a great teacher* (int. 1).

In this discussion she presented a few key aspects about teachers – that they are fun to be with and engaging, that they are welcoming and have good relationships with students, that they know their content well, and that they extend the work of teaching beyond the classroom (to home) and beyond the typical school day. In her experience as a student, this was a regular occurrence.

About math specifically, she found that she excelled in it as compared to her school age peers. She also took the ability to teach peers math as evidence of her

competence. She framed the ability to explain math or other content as demonstrative of deep knowledge about it.

> *I feel like I can explain [math] a lot better [than others]. Because, if you know why everything's happening and the reasons behind why you are just doing something, it makes it easier to explain to people because they can ask you the most random questions and you can think about why, so I want to teach it because of that. I feel like I've always been able to thoroughly understand it and, like, so many people struggle with math and I'm good at it. I'd like to think I can teach people.*

Here, Tanya adds to some of her understandings about teaching that recurred over the course of the study: (1) teaching as a way of demonstrating subject matter knowledge, (2) the practice of teaching as explaining, and (3) her own competence in math as unusual when compared to peers.

From math student to math teacher.

Tanya began her undergraduate years at Cliff with a double major in physics and math. Over the course of her first year there, she decided to focus on math exclusively. Of the candidates who completed their math degree at Cliff, she was the only one who chose the 'pure mathematics' track which was seen as the most rigorous path through the major with an emphasis that extended beyond computation to deeper analyses of math concepts. She excelled in the major and enjoyed the kinds of puzzles that were part of her coursework. She was recognized for her accomplishments in the major in part by being hired as a teaching assistant for calculus, a position often reserved for graduate students.

It was through this work that Tanya learned about Teach STEM in her junior year; the course professor recommended her. She participated in the program for one

year and completed two quarter-length internships. One was an algebra one class for eighth and ninth graders in a 7th to 12th grade charter school and the other was algebra two and trigonometry in a comprehensive high school. Neither of the schools would be considered high needs; in fact, they shared demographic and academic features with the kinds of schools she attended for middle and high school. She pursued the internships but not the STEM or traditional education minor. Tanya was initially disinterested in coursework about education.

Through the internships, she developed a strong interest in some of the practical aspects of teaching. As someone who had not considered teaching as a career, she became intrigued by the level of intention and planning it takes to teach.

> *I really liked it. It definitely started to open up my eyes more. I never really realized how much had to go into teaching in the classroom. [For example] we talked about the seating chart and I was like, oh my god, I didn't realize that was so important. And then, it was cool to go into high schools* (int 2).

She credited the time in Teach STEM for helping her develop a sense of ease in the classroom and the ability to develop relationships with students. When she began, she was reserved and even reticent to engage. With more support to participate (e.g. teaching math warm ups, something that was consistent and modeled) she found more ease in classrooms in general and with students specifically.

> *It's helped me now because I'm used to being in classrooms. Whereas when I first went to [my initial internship], I was kinda scared and mainly just sat back and didn't get too involved in the class. I was really unsure about everything. But then, at [my second internship], I started getting more involved and I had a teacher who would make me teach warmups and stuff like that… I feel like I know how to act [in a classroom] more and get to know students because I've already worked on that for a while* (int 2).

The school sites where she interned were relatively affluent and the students she came to know through Teach STEM were often academically astute. They were, in many ways, similar to the kinds of schools Tanya attended herself. There were also students from underrepresented groups, some of whom struggled with the math content. It was her there Tanya became curious about teaching as a level for social change and she framed an interest in teaching in diverse schools, as she said, "so that I can actually make a difference compared to one where all the kids are white and upper middle class and will succeed with or without me (int. 1).

Reasons for Selecting Math Teaching

Tanya chose to pursue math teaching because of her love of the subject and the understanding that her ability to explain math concepts could help "*make a difference in some students' lives*" (int 1). This was spurred largely by her experiences in Teach STEM. The application and financial supports they received to apply to the MA/C, were also significant in her choice to teach as well as the opportunity to stay with some of her undergraduate peers for another year.

> *I was already going here [as an undergrad] and I did Teach STEM and they're like, yea, scholarships! And we'll help you apply to the program. And then all my friends in Teach STEM they were all applying to the program. It was just kind of something that we all did. I was like, 'oh yea, I'm applying to the program'. And, you know, Teach STEM was like 'I don't see why you wouldn't get in'. And so I said Ok.*

She also referred to the potential of teaching to reduce her student loans[11] and she enjoyed the portability of the profession, as she anticipated moving to Hawaii once she cleared her credential and completed the high need school teaching requirement.

Her experiences as a K-12 student confirmed her math competence; it came to her easily and enjoyed it as a kind of 'puzzle.' Math itself was the draw to the major -- not it's applications. She understood that this distinguished her from others. "*I feel like I've always been able to thoroughly understand it and, like so many people struggle with math and I'm good at it… I love doing the nitty gritty problems and getting an answer*" (int 1). Her reflections on her own schooling in general and math specifically focused on (1) her own aptitude to understand and explain math and (2) close relationships with teachers.

Missing from her narrative was a reflection on the ways that she and others were taught; this meant that she did not address the affordances and/or constraints of her own experiences or a sense of others' school experiences beyond her own peer group. Her critique at the start of the MA/C program was based on the largely homogenous schools where she interned through Teach STEM with classes of student who were, in the main, academically successful, white, and from middle and upper middle-class backgrounds. She was critical of schools with this type of a homogenous population; she felt they were exclusive in ways that harmed students who did not fit in with the dominant group. Although these schools were similar to the ones she

[11] Like Pierce, she anticipated applying for APLE for loan forgiveness.

experienced as a student herself, Tanya did not seem to make overt connections between them and her experience as a K-12 student.

Student of Teaching.

During Teach STEM, she saw theory classes as "horrible and boring" but had a different experience in the MA/C program. It was here that she began to develop an interest in teaching beyond her own math competence and relationships with students. Through coursework specifically on multiculturalism in education and sociocultural theories of learning, she framed another hope for schooling – social change.

She referred to the classrooms from Teach STEM where students from underrepresented groups and/or those who struggled with math were the minority to frame social change as a personal teaching goal. At the time, she was compelled by a movie about revolutionary Che Guevara as a young doctor who volunteered in a leper colony as part of a longer trip and during a time of personal transformation. Here, her deepening understanding of barriers for low SES students of color in schools in tandem with her own developing understanding of social change came together. To address this as a student teacher, she requested that both of her student teaching placements take place in a local rural, agricultural, largely Latinx, and low SES community. Given the available schools to student teach, this choice put her at sites that were the furthest from own schooling experiences and in many ways these sites were a sharp relief to those she critiqued from Teach STEM as the student demographics were essentially inverted at these sites.

Over time, and through student teaching, she broadened her critique to reject all schools that were largely homogenous – those like her own schools and the ones she experienced in Teach STEM and those that were largely students of color, like those from student teaching. Within the first few weeks of student teaching, she came to dis-identify with the schools and students as she began to feel like an outsider, culturally, socially, and linguistically. Her sense of herself as not being a cultural match for the students influenced her analysis of the teaching and classroom management at these sites; she interpreted some of the more rigid practices as culturally specific. With this deficit framing, Tanya came to believe that some of her own hopes as a teacher (e.g. to be fun, well-liked) could not be realized in a high need school.

At the start of student teaching, Tanya's pedagogical interests focused on cooperative and language rich ways of teaching math. However, over time, she integrated the teaching strategies she experienced during student teaching which was a complex bundle of sometimes contradictory approaches. For example, she worked extensively on drawing on students' prior knowledge to teach new concepts. An example focused on distributing rational numbers to prepare for distributing with radicals. "*Today we were distributing with radicals so for the warm up, I put a distributing problem but with number and then could show the students that it was exactly the same but now we are going to do it with radicals*" (int. 3). At the same time, she adopted an approach math notes that included of listing the required steps for a problem on the left side of the page and then doing the computation on the right.

The challenge for Tanya was less focused on teaching strategies, although there were many examples where she encountered contradictions in her teaching, but more so the largely controlling and punitive approaches to classroom management. She came to interpret these approaches as context-specific. It was here that Tanya quickly shifted away from a social change orientation. She developed the perspective that students in schools such as the ones where she did student teaching (largely low SES and Latino) required a more of a control-oriented approach to classroom management and, similarly, a didactic approach to instruction.

> *From day one, [the CT's] been super strict. And it's weird. Like all of the kids have to line up outside the classroom before they come in. Then she hands them papers they have to do… I want to have a more relaxed atmosphere. But it seems like working in a school like that where you'll have to be strict otherwise you'll just be walked all over and those kids, they almost need you to be strict* (int 1).

She made the problematic and deficit-based assumption that this population of students needed a more behaviorist approach to student motivation and authoritarian control over students – '*they almost need you to be strict'*. In this phrase, Tanya both distances herself from the students she is teaching and makes an assumption about their shared nature as requiring a punitive form of discipline to participate or learn.

She adopted an external motivation strategy and ledger approach to teaching where individual students had to earn points added for participation and lose them for any number of behaviors. She pushed back on the modes of teaching favored by the MA/C program, making the assumption that they were not possible at these sites. This influenced her teaching as well as she moved away from her original hopes for

constructive student-led learning. Although she was at times critical of these approaches, she generally did not deviate from her CT's approach. For example, reflecting on a lesson she observed, she felt that the students did not understand fractions because the CT "*just told them [how to do it and] they have no experience with them at all"* (int 2). She understood that telling was not teaching, telling did not even reach the low bar of 'teaching as explaining.' Understandably, she felt it was too big of a task for a student teacher – to change modes of instruction and management in someone else's classroom. "*That is how they learn right now. I can't change it because they don't know how to learn any other way. I can't come in and restructure this whole class… that's way too big for me to take on*" (int 2).

It was through these experiences that Tanya contrasted the MA/C program's focus on social justice to her desire for a relaxed classroom and a growing misconception about students' background and capacity to learn beyond control-oriented approaches. "*I know this program is all about social justice, like promoting that and everything which I'm all for… But I'm not the type of teacher who's going to work in an urban low-income school. That's not for me because I really don't like to discipline*" (int 3). 'I really don't like to discipline' was a perspective both on herself as a teacher and, again, her deficit framings of the largely Latinx student body at her student teaching sites as requiring authoritarian modes of discipline.

What she then developed was a sense of an ideal school site being one that was "diverse" with diversity read as heterogeneity.

> *I would like to teach at a diverse school, I think. Like, [my current school is] almost all Latino. I don't want to teach in a school like that. I want an actual*

> *diverse school…like even the first period class I had this morning. They're in the 7th grade and stuff and there are so many of them that don't, that have given up on school already. And, it's only like 2 weeks into the year and, like, it's kind of sad. But, in a way it's like they're all one group so it makes it easier for them to band together and be like, yea, yea. I don't know. So, I want a more diverse school or something… maybe minorities feel like they've been beaten down by the system and how can one teacher, one math teacher change that? I want to have students who are enthusiastic.*

Here, Tanya outlined some deficit assumptions about the students at her placement sites. Her sense was that the students had a collective Latinx identity that compelled them to disengage from schooling and 'band together' as a form of resistance to learning. Reducing the students' identities to one large cultural group, Tanya came to see herself as an outsider; both her and students' identities were racial identities exclusively. "*I want to teach in a school where I feel like I fit in more with the student body… I want it to be more where they understand where I'm coming from and I understand, like, where they're coming from*" (int 3). Since her CTs were themselves Latina and spoke Spanish, she did not look for other reasons that she might have felt out of touch with students. One of her main hopes as a teacher was to build relationships with students. However, in the student teaching year, she often eschewed opportunities to get know students as individuals.

Math teaching.

After completing her credential, Tanya taught in a rural California high school. This is a school that has chronic student achievement and teacher retention issues. The district partnered with the STEM Scholars program at Cliff in hopes of hiring more qualified STEM teachers That year, she was the only candidate who

applied from Cliff who applied there. She became more interested in the school after the interview.

> *It was just three people interviewing me… And it just felt like I was having a conversation when I talked with them, and it… felt really easy to talk to them, and they were really nice and welcoming. And the human resources staff who had called me about setting up an interview and all of them, they were all just so helpful. So, it was just like everybody just seemed like the easiest person to work with, and I felt welcomed and not like some little kid who was being interviewed by a panel that couldn't even smile*. (int. 4)

The warm welcome and sense of ease she experienced with the interviewing teachers and district staff distinguished the district. Similar to her student teaching placements, the school was primarily Latinx with poor teacher retention, so it qualified to meet the high need requirement for Tanya's STEM Scholars funding.

Her transition to full time teaching was challenging as she moved from planning one prep for student teaching to three plus as a full-time teacher. Consistent with her earlier ideas that explaining something well was a way of showing mastery, she understood that planning her lessons required her to work through the problems before using them in class. "*I learned the hard way the first week, where I would be here until 6:00. I would go home and then I would continue planning… It was a nightmare, and I would've quit if there was another week like that* (int 4). Very quickly, she revised her approach to planning so that she planned all lessons once a week and, over time, reduced what counted a preparation. "*At first, planning took a lot longer than it does now because I was really thorough with the notes… looking up everything, doing all the homework… it took forever planning*" (int 4).

She felt a sense of comfort and collegiality with her math department peers and felt that the math department culture was a match for her. She found them to be supportive and willing to share course lessons and materials. "*[With] any questions I have, people are always helping me, like, I don't know. It's just been—everybody has been really helpful*"(int 4). This did not necessarily lead to innovative planning but it did help reduce her workload which was one of her primary motivations during the first year of teaching. She also appreciated what she saw as a 'straightforward' approach on the part of department and teaching peers.

> *I like it because they're like real. It's not like you have to go in and be like oh, every student can learn. Like, they aren't just—you know, we just need to help them and better support… [and] they can be like no, that kid is just being a brat and you need to kick them out and call his parents, and write a misconduct. I don't know. I like it. Because we don't BS around, they don't like fluff up everything where you have to sit in meetings and like fill out all this BS. Everybody knows it's BS and we all talk about it and we just get it done and then, move on.*

She transitioned away from daily planning to weekly but at the same time adopted an increasing textbook-driven and didactic approach to instruction.

> *I used to get here really early but that has ended. Now, I just come in, I flip open the book and look at the section I'm doing for algebra, I maybe make a few copies of a worksheet or something. Teach that to them (int 4).=*

Tanya focused primarily on her classroom instruction and some of what happened in the department to the exclusion of larger school or professional development efforts. By the second year, she had established binders of lesson plans, some of which she used again and started the year with a stricter approach to classroom management.

Although she planned to stay in teaching until loans forgiven, she gave notice. At same time she, and fifteen other first and second year teachers at the school were non-reelected, a decision that came down by the school board.

> *So two days before I found out about this I had turned in this slip of paper saying that I wasn't sure of my plans next year because I want to move to Maui. And then two days later I got a non-reelected and so I'm actually moving to Maui. I got a job teaching there at a charter school.*

Having completed the two years of teaching in a high needs school, she chose to teach in an academically advanced charter school with a lower student/teacher ratio.

Summary

Tanya exemplifies one way that candidates respond to recruitment efforts – she became a short term, math proficient teacher for one high need high school's math classes who (1) had not considered the profession prior to recruitment efforts, (2) was supported to complete both the major and credential plus master's degree, and (3) leveraged teaching as a career for other goals (for Tanya, this meant mobility and eventually leaving the country). However, her deficit assumptions about Latinx students caused her to both disengage from the learning trajectory she anticipated for herself as a teacher and she privileged a more control-oriented and didactic approach to math teaching.

Chapter Summary

In this section, I review the features of teacher identity identified in the literature (c.f. Rodgers & Scott, 2008) with attention to what emerged in these math teachers' development to offer a theoretical understanding of this process as not only

individually held but also socially constructed and culturally figured through interaction with the sites of recruitment, preparation, and throughout, teaching practice. Addressing the contrast between the individual and the context is critical in understanding the role teacher recruitment and preparation play in math teacher development.

Identity is formed within and across contexts.

Findings from this chapter call attention to the significant shaping role that one's own experiences in and across contexts – as a student and those offered by practice sites, internships and student teaching – has on how one perceives and enacts themselves as a math teacher. Regarding field experience, specifically, research highlights the importance of strong placements to develop perspectives on teaching and learning, and related practices; this study addresses some of the processes involved in that process of reification and disruption. As Rodgers and Scott (2008) noted that we "do not perceive contexts… as much as we absorb them, often taking for granted what is 'real'" (p. 734). The norms of teaching tend, then, to be replicated. Part of the challenge that both Carmen and Tanya faced, was that their own success in school and congenial (though vastly different) relationships with their teachers made it difficult for them to analyze the contexts of their own development as students. Consequently, they also did not sustain analyses of the teachers who mentored them as beginning teachers. Both were initially critical of some of the school and CTs' practices but both also adapted to the practices. Context and exposure to particular norms of teaching, especially because they were minimally mediated or analyzed,

tended to construct and reify existing norms of math teaching with an emphasis on didactic structures, as well as control-oriented and deficit-framed orientations to students who struggled.

Identity is formed through relationships with others and involves emotions.

I found that the candidates' alignment with cooperating teachers over other instructors or even peers was significant in their teacher identity development. As they came to increasingly identify with the CTs they positioned themselves as certain kinds of teachers. This extended beyond functions or roles they would take on in the classroom and extended to become frames of meaning for how they interpreted themselves as teachers. For example, Carmen who was initially uncomfortable with the level of control enacted by her CT, came to mirror her practices. While this was initially a way to please the CT, it later became a logic of her own practice. When she transitioned to solo teaching in the placement, she found the students 'needed' a higher level of discipline than she anticipated. This focus on control extended beyond the student teaching period to her own practice as a teacher.

However, these relational aspects of identity formation were not always unidirectional. We see that in the case of Pierce who leveraged his experiences in courses and in other placements, to bring new or different practices to some of his mentor. Consider his longer-term student teaching placement in two classrooms with two very different kinds of teachers. At the outset, his teaching in each class mirrored the respective CT. As he faced moments of disruption which evoked emotions that

troubled his sense of himself as a teacher, he made choices about his practice such that his practice in both classes were more similar.

Identity is 'shifting, unstable, and multiple.'

While there were aspects of the candidates' teacher identities that appeared to remain quite durable over the course of the study, who they became as teachers was not predictable and, indeed, shifted over time. This resulted in multiple renderings of how they understood and enacted themselves over time. Some of these shifts were evident in contrasts between their idealized teacher selves to those they came to understand and enact. However, at times, who they were as teachers was more of a situational phenomenon than an individually held one.

Identity is constructed and reconstructed over time through stories, highlighting the integral role of language, specifically narratives.

Empirically and analytically, language was essential to understand teacher identity development as I privileged interviews and the narratives the candidates told. as the primary data source for this study. Through the telling and re-telling of their stories (to me, to themselves, to each other, etc.,). These stories were ways of validating who they were as teachers, often in line with the school sites where they practiced and, at times, in tandem with coursework and the MA/C program. Using the research interview to discuss experiences across contexts and time periods allowed for a focus on their developing identities rather than experiences as they are sometimes narrowly defined in work on math teacher identity. Through narrative, the

candidates explored their biographies, defined who they hoped to be as teachers, and constructed their teacher identities.

Chapter Six: Findings

This chapter examines the construction of the candidates' teacher identities in relation to their prior experiences as math students, the contexts of teacher recruitment and preparation, as well as the school sites that the candidates participated in and were later employed. This focus is specifically on those personal and programmatic aspects that led candidates to replicate the norms of math teaching. Drawing on Pierce as an exemplar for current math teacher recruitment and pedagogical reform efforts, the question that guides this chapter's analysis is: **how it is possible that Pierce disrupts these norms, rather replicates them?**[12] I address this question to offer some analyses on what allowed Pierce to disrupt. Chapter seven follows with practice, policy, and research implications to inform math teacher recruitment, preparation, and teacher development.

A recurring and dominant theme from this research was that the beginning math teachers' identities developed in ways that were simultaneously highly personal and also reflective of the contexts of their recruitment, preparation, and ongoing practice. Their experiences as math students, hopes for themselves as math teachers, and the contexts where they were prepared, and later taught, mattered – but not in predictable ways. Of the three candidates that are the focus of this research, two of them – Carmen and Tanya, both from vastly different social, economic, cultural, and education backgrounds – tended to replicate the well-worn deficit-based and didactic

[12] I am not suggesting that replication and disruption exist as a kind of a binary where one completely replicates the norms and another completely disrupts. Certainly, we see elements of both in most teachers. However, contrasting these candidates and their approaches to curriculum, instruction, classroom managements, and perspectives on math learners and themselves as math teachers.

norms of traditional math teaching. Those norms that appeared regularly in the data were: (1) aptitude in math is an exclusive property (some have it, most do not), (2) deficit notions of math learners such that math achievement either comes naturally or is the result of individual student's efforts, (3) didactic approaches to teaching math, and (4) control-oriented approaches to classroom management.

Pierce is a math teacher that, in many ways, exemplifies the goals for current recruitment efforts for math teachers. As an almost accidental math major, he was recruited in through Teach STEM, the undergraduate recruitment program, partly because of the financial incentives and his extended peer network. He was financially supported to complete the MA/C program, fulfilled his obligation to teach in a high need school for two years and still teaches there, now eight years post-credential. This recruitment to retention path is an important one. However, in light of reforms in math education, what makes Pierce's case so necessary to understand is that, unlike his MA/C program peers in this study, he teaches in ways that disrupt the prevailing norms of deficit-framings of students, didactic approaches to teaching, and authoritarian modes of classroom control. In their cases collectively, we begin to see the line between qualifications and quality which is a persistent gap in the current literature on math teacher recruitment and retention.

This chapter examines those aspects of the candidates' development that positioned them as either replicating the norms of math teaching or disrupting them. I found two salient themes focused on how the math teachers' identities developed in relation to biography, socialization, and their recruitment and preparation programs.

The first theme was that students' participation in Teach STEM created an insulated path from recruitment to preparation program and, later, teaching that calcified their early conceptions of math teaching and themselves as math teachers. I address this aspect of their development primarily through the lens of Lortie's (2002/1975) 'apprenticeship of observation.' While all candidates shared some common approaches to their own teacher development, often reifying conceptions of math learners based on their own experience, they differed largely in the kinds of experiences that they brought to bear on their teaching. Participation in Teach STEM created a *linear and insulated process* where candidates often sought field experiences that both mirrored and reinforced their own schooling experiences. In Teach STEM, the focus on recruitment and career preview, often minimally mitigated by alternative perspectives, meant that their incoming ideas about teaching and themselves as teachers were mostly solidified, rather than challenged and changed. Analysis of their own experiences as learners and with (or of) math teachers was also significant in revising dominant teaching practices – or not.

The second theme was the ways the math teacher candidates used the notion of a cultural match to decide on the kinds of school sites and student populations that they can and should teach. Cultural match refers to the idea that students of color might find more resonance with, and therefore perform better academically, if assigned to a teacher of color. Generalizations about this construct influenced candidates' assumptions about the students they taught and led at times to narrow understandings of how to teach those students. For Tanya and Carmen these narrow

conceptions of culture and student-teacher fit further reified deficit framings and a reliance on traditional modes of math instruction. This section addresses how the candidates made sense of the relationship between student and teacher racial identities and the ways this influenced their development.

Enduring Effects of the Apprenticeship of Observation

Beginning teachers' perspectives on teaching are often quite durable due, in part, to their longtime exposure to teaching from their vantage point as students. Teacher candidates who felt well-served by their schooling experiences, as was generally true for the teachers in this study, may not have developed a critical analysis of the educational system that is substantive enough to alter their perspectives. These two aspects – prolonged observation of teaching from the perspective of a student and developing a critical analysis of teachers and teaching – are central to the enduring perspectives that the candidates brought to their development and work as teachers.

The consistency in their perspectives is not a new discovery. This is often referred to as the 'apprenticeship of observation' drawing from Lortie's (2002/1975) canonical research on teachers and teachers' work. He wrote that "[t]here are ways in which being a student is like serving an apprenticeship in teaching; students have protracted face-to-face and consequential interactions with established teachers (p. 61). So, teacher candidates bring with them assumptions about the tacit work of teaching based on those aspects that were observable, primarily instruction and interactions teachers had with themselves as students. For math specifically, the models that the

candidates had as students were often inconsistent with the kinds of teaching anticipated following current reforms in math education.

Given that this extended term of observation often solidifies perspectives on teaching that, at their best, are incomplete (considering mostly what was in plain sight) or, at their worst, reify inequitable practices, the process to transition from students to teachers is a particularly important one. Teacher education is charged with a formidable task – to disrupt, in many cases, over sixteen years of teacher observation. A one-year teacher preparation program such as Cliff is a relatively short intervention in the face of such long-held perspectives.

However, unlike typical California candidates who enter teaching through traditional teacher preparation programs, these math teacher candidates experienced *a longer time of career preview*. Their participation in Teach STEM provided them with early exposure to, and engagement with, math teaching. This extended career preview occurred in sites selected by the candidates which generally mirrored the kinds of schools and demographics they experienced prior to college and provided minimal opportunities to disrupt their perspectives. The moments of disruption themselves were also important to explore as the candidates' responses often reified their incoming perspectives rather than spur change.

As a recruitment program, Teach STEM exists to draw more potential candidates to the field of STEM teaching. In this aim, it is successful. Of the five candidates who entered the math credential through Teach STEM, all of them completed two years teaching in a high need school and all of them taught at least five years in a mix of

settings, some of which were high need. Teach STEM focused on the internships with stipends to bring potential candidates to teaching. Teaching practice was both a draw to teaching and a site of reification such that enduring perspectives about math teaching and learning were confirmed and even calcified.

Limited analysis of their own teachers.

One notable feature of the apprenticeship of observation that was present in these candidates' experiences, both as K-12 students and in Teach STEM was the limited analyses that they brought to bear on these experiences. For Tanya and Carmen, specifically, their discussions of former teachers tended to privilege personal attributes with minimal attention to pedagogical practices. As Lortie (2002/1975) noted in his discussion of the apprenticeship of observation, the sense they made of their own experiences with teachers was "intuitive and imitative rather than explicit and analytical; it is based on individual personalities rather than pedagogical principles" (p. 62). This means that candidates often bring with them personality-focused typologies of their teachers, rather than analyses of teaching and learning. This was coded in the attributes that both Carmen and Tanya used to describe their experiences with teachers, focused on teachers' personality features.

Carmen described her good math teachers being 'nice and approachable' even though this was something of a contradiction with her sense that her success as a student depended, at least in part, on her ability to get good grades without requiring much support from teachers. Her personality-driven characterization of the teachers did not address the relationship between how they enacted themselves and the ways

they taught. In fact, her vague, albeit positive, conception of teachers relied heavily on student initiative for learning to occur. In her discussions of high school math classes, she described both her ease with the content and her teachers. Her focus was less on the teachers and more on her interest in and facility with math. That her teachers were 'approachable' was a contrast to how she saw herself as a math student. She valued her own initiative and, distinctly, her ability to not engage with the teachers. Her ease with the subject and self-directed approach to learning made the teacher almost unnecessary.

Even as Carmen came to reanalyze her own educational experiences and broadly critique her teachers for not preparing her for the rigors of college, her characterizations of them remained fairly consistent. They were at once 'nice and approachable' and at the same time let her down. As she became aware of the gap between her high school experiences and that of her peers, and even when she wished more had been offered to her, this was rarely codified in an analysis of what her teachers offered pedagogically. In part, you might consider that challenging her teachers more concretely would also require a re-analysis of herself as a student. One reason why candidates, particularly those who were normatively successful in schools, may be loath to critique their teachers is that such critique implicates them as learners as well. For both Carmen and Tanya, those aspects of themselves that they credited for their success tended to override critiques of their teachers. Another consideration is that the wide berth of who can be a teacher if the typologies are

personality-driven generally leaves plenty of room for most people to become teachers.

Tanya and Carmen's schooling experiences existed on opposite poles of the public education continuum. While Carmen was in an underachieving public school, predominantly with students of color from low SES backgrounds, Tanya's schooling was with predominantly White students from middle- and upper-class backgrounds. Both were in settings where their own demographics were the dominant ones – and they both felt prized in those settings for their high grades. However, the teachers they encountered were quite different. Tanya described her good teachers as 'fun and engaging.' For her, school was an enjoyable place where she befriended a group of peers who were similarly successful in school, all of whom enjoyed good relationships with their teachers. Learning, and being pushed to learn by teachers, was a gratifying experience. Math itself was a puzzle that she enjoyed figuring out. Much like Carmen, however, Tanya did not present an awareness or analysis of her teachers beyond those that were personality-driven or relational.

While Carmen's teachers remained at a distance, Tanya's were interwoven in her life both in and out of school. She described sharing holidays with her friends at teachers' houses. Tanya could rely on her teachers to not only know their subject matter well but to create a teaching situation where the students could have fun. She enjoyed those aspects they brought in that were tangential to the topics at hand. For example, a favorite teacher would share stories of his childhood and bring yo-yo tricks to the class. So, while her understanding of teachers was more tied to classroom

practices than Carmen, they still existed largely outside the realm of pedagogy generally, or math specific approaches in particular. For Tanya, good teachers were those who create a context of fun, push their students academically and spend time getting to know their students well as individuals. References to academic growth with teachers focused also on personal dimensions – holding extra study sessions, at times at the teachers' home with food provided.

Their discussions over the course of the study do much to differentiate between the norms of teaching that they were both accustomed to but, again, primarily focused on personality-based and relational dimensions of teaching. It became clear that while Carmen anticipated very little support from her teachers, Tanya anticipated individualized support within a context of fun and close relationships with teachers. Neither, however, addressed math teaching beyond these general features.

These perceptions were minimally disrupted when they participated in Teach STEM. Carmen chose placements in schools where students and teachers were predominantly Latinx in a rural community marked by low SES and many students, like herself would be among the first to graduate high school in their families. It was in these experiences that she confirmed for herself that her cultural identity and bilingualism made her a unique fit for teaching in this community. This was reinforced in the classes she took in the STEM minor; the ones she chose attended to diversity and issues of race in schools. Specifically, she learned about the notion of a cultural match that students perform better when they share their teacher's ethnicity.

Generally reserved, her participation in classrooms focused on individual and small group support of students which she leveraged to get a job as a teaching assistant for the migrant education programs at one of these school sites. Taking this opportunity as one where she could observe and essentially assist in the classroom, her conceptions about math teaching were further solidified. She enjoyed the relationships with students and came to increasingly value her own cultural and linguistic assets for teaching but did not have many opportunities to teach a whole class.

Tanya, on the other hand, chose placements in schools with predominantly White students from middle and high SES backgrounds. While she still privileged the notion of the fun teacher and experienced this at those sites, she was beginning to notice two things: 1) that there were skills to be developed in order to teach and 2) that although most students at that site were academically successful, those who were not largely did not receive the support they needed. Eschewing any campus courses focused on theory or teaching methods, her introduction to teaching beyond her own experiences as a student existed exclusively at these practice sites.

Her intrigue in the methodology of teaching was important. Understanding that the choices the teachers made were intentional rather than random (e.g. seating choices, structure of activities, the use of homework, etc.,) intrigued her. It led her to consider how to teach so that all students were engaged and included. These considerations created a space for her to begin analyzing the work of teachers and herself as a teacher. However, her analysis of teaching remained narrow. In part, the

self-guided structure of the program meant that she could choose whether take classes to supplement the field experience and she did not. Also, without a supervisor or someone outside of the classroom to debrief these experiences with, her understandings focused less on pedagogy and more on classroom management and control mechanisms. Without external support, candidates were left to make their own sense of these practice experiences; mentor teachers could guide that process if they chose.

In contrast, Pierce developed a critical analysis of his teachers through his experiences as a student. His school was more heterogeneous demographically than the others and he recognized his schooling experience as unique from that of his peers who attended the same schools. He described being 'tracked' into higher level math classes from a young age and could not discern whether it was his success in math which led to his advanced placement or if having exposure to more difficult content guided by what he perceived to be better teachers produced a kind of math competence. This awareness, that his success might have been produced through schooling and teachers rather than (or co-occurring with) something innate is part of the analytical lens he brought to bear on his teachers. This same lens is the one he applied to himself throughout Teach STEM, student teaching, and beyond and, at least partly, explains some of the differences between Pierce and the other two candidates.

His examples of good teachers were grounded in pedagogical approaches that focused on process, depth, and collaboration and he rarely delved into matters of

personality. Recalling a favorite class on Science Fiction literature, which was an elective, he noted that the casual atmosphere allowed for deeper engagement and that he appreciated the quizzes that were less about discrete facts and more about ideas. About math, specifically, he was aware that some of his math teachers engaged in collaborative learning such that teaching others became a marker of success. The exchanges between students were, in some cases, more important than earning good grades.

Pierce's experience in Teach STEM extended this analysis. While he was initially drawn to the recruitment program through financial incentives and relationships with peers, he quickly recognized that he enjoyed the work of teaching from the vantage point of a teacher. As an intern teacher in Teach STEM he was invited to teach regularly, moving from one-on-one experiences to small group and then whole group teaching. He noticed that the classes where didactic teaching was the norm, much like many of his own teachers, were easier to participate in because the strategies were known. A typical class might move from homework review, to direct instruction, to guided instruction, and then independent practice. There was a certain ease with these well-known structures. However, he was critical of this ease. Drawing on his own varied experiences as a student and his growing interest in sociocultural theories of learning from the courses he took in the STEM education minor, he challenged himself to try out some of the strategies he learned – and the mentor teachers supported this. Through this experience, he was able to make better sense of his own experiences and teachers' strategies which he referred to as 'social

learning.' He brought these to the Teach STEM classrooms and found the teachers to be receptive. While he did not change the classroom practices at those sites, he was often given the latitude to try out teaching ideas. At one site, where he was later hired, sociocultural approaches were the norm of the classroom.

Analysis of their teachers became important as they moved further along in the recruitment and preparation process and discerning what kinds of math teachers they would strive to be. Attention to personality and relational dimensions of teaching made it difficult for Carmen and Tanya to parse through their own past educational experiences to set professional goals beyond credential completion and employment. However, this limited analysis also appeared to influence their choice to pursue math teaching as a career. As Lortie (1975/2002) noted about his findings, these chosen attributes "were less likely to force self-elimination than would more stringent standards of self-assessment… there is a social psychological correlate to structurally eased entry; in both instances the hurdles are set at the lower notches" (p. 40).

The wide berth of a personality-focused framework on teaching meant also that they were less likely to exclude themselves from teaching. Their understandings of math teaching, then, were largely developed not from a deep understanding or analysis of teachers but was reflected through their understandings of themselves and others as math learners.

Experience of themselves as math learners.

Drawing on their successful histories as math learners, all of the teacher candidates related their choice of math teaching, at least in part, to their own comfort

with and ease of learning the content. It was a kind of *biographical extension* where success in math, understood as uncommon, a kind of exclusive property, became a common-sense component of their entry to teaching. It was a way to cohere their early experiences to their future careers (Fairclough, 2001; Linde, 1993).

Their personal narratives of success in math came with an opposing perspective on *other* students as struggling, that as Carmen noted "many students are scared of math". Tanya also described the necessity of math "to make it in today's society." Together, highlighting the simultaneous difficulty with, yet need for math for success.

Their success in math gave them a vantage point to not only view themselves and frame career goals, but also shaped their perspectives on others (including their students), as generally unsuccessful or disinterested in math. So, while their positive experiences became part of their own narrative about their academic success, specifically in math, and that this was unique, a kind of exclusive group, simultaneously they constructed an opposite perspective on others as generally not good in math. For example, when Tanya described her early experiences as an 'accelerated' math student in high school, she also talked about tutoring her peers. She said that she helped in math "because that's where people always need tutoring" (Tanya, Int 1). If their success in math was uncommon, even exclusive, then a purpose for teaching was to expand interest and aptitude in math.

In the cases of Carmen and Tanya, they described not only excelling in math but also having fun with it. Math was not just a subject to comprehend but a pleasurable pastime. In contrast, Pierce described himself as being good at math, but liking other things more. His choice to pursue math teaching was anchored in both his competence in the subject and his explicit focus on the practice of teaching. This was consistent with earlier research, where engagement with the subject was a larger draw to the profession than the practice of teaching students. Andrews and Hatch (2002), in research on math teachers' reasons for selecting teaching described that finding that "enjoyment of the mathematics… [was] a significant career motivation while for a small number their decision was informed by a desire to offer children something better than they had experienced as learners" (p. 191). This finding, focus on their own student experiences with the subject matter over teaching practice, had implications beyond career choice as I found that it shaped not only the choice to teach in general but focused the candidates' development.

All of the candidates made assumptions about their students (from Teach STEM to the MA/C program and beyond into teaching) based on their own experiences as students. These conceptions were further reified through participation in Teach STEM and, variably, through their student teaching experiences in the MA/C program. Carmen and Tanya's collective focus on math as enjoyable and their tendency to prioritize students with similar perspectives meant that they focused on students who were similarly interested, capable, and motivated. Pierce, who was also successful as a math student but more interested in the practice of teaching than the

subject matter specifically did not assume that students would enjoy math. Without this assumption guiding his work, a wider variety of students in his classes could be deemed worthy of his attention and treated as successful.

As a student, Carmen focused on her individual determination and motivation to do well in school. From elementary school on she found that she was "the student that [teachers] liked. They could always depend on me for like getting my work done. Pretty much the teacher's pet" (int. 1). Recall that through Teach STEM and the STEM education minor, she focused on teaching Latinx English learners who would be among the first in their family to complete high school and possibly attend college. For her, this general notion of a cultural match between teacher and student took on a more specific dimension as she codified "English learners" as particular kinds of students. They were a lot like her. "A lot of the English learners are actually the best students… They're good students. They do their homework, which obviously we still care about, and they'll pay attention and, you know, do their work" (int. 2).

Her work with individual students during Teach STEM confirmed this. Once she transitioned to student teaching in the MA/C program, it was clear that this conception of English learners did not refer to the whole of the group but only those students within it that matched this description. Her teaching attention focused on that small group within a class full of English learners. She attended almost exclusively to their learning – and looked to their accomplishments to gauge her teaching successes. This focus continued once she was hired as a teacher. In the first year, her students were not those that she read as academically motivated. Carmen started her teacher

preparation program knowing that she would struggle with students who were not motivated to do well in math. However, through Teach STEM and the MA/C program she consistently had students who were like her. When she began teaching her own class and did not have those students, Carmen focused on modes of classroom control to compel motivation. She blamed the students for her bad mood and anger with them which she felt was caused when they did not follow these norms of individual determination to succeed academically.

Tanya's history as a math learner also superseded her conceptions of good math learners. She is someone who was academically successful across subject areas with close familial ties to some of her teachers and who, along with her peer group, enjoyed academic challenges. Tanya came to Teach STEM through her own academic accomplishments, being referred by a Calculus professor for whom she was a teaching assistant. Initially, she did not discern the need to learn about teaching as its own area of study. Her experiences as a student suggested that academic success came through a set of individual dispositions and capacities that was supported through fun teachers who get to know their students well and push them academically.

For Teach STEM, Tanya chose school sites and was assigned to classes that were similar to the schools she attended both in terms of demographics and, for the classes, they reflected higher levels of academic achievement. This served to also confirm some of her incoming perspectives of students as individually competent and thriving in contexts of both fun and academic challenge. During her second Teach

STEM internship, her mentor teacher charged her with more teaching responsibility than she had previously. The shift created a kind of disruption in her perspectives – an important one, despite the fact that it was not sustained. Taking on teaching roles allowed her to notice those students who were not doing well. In these contexts, however, these students were the exceptions. She became curious about teaching as a way to redress inequities. Knowing that there were skills that she could learn and that the general approach she prized did not actually work for all students, she began the MA/C program with the intention of teaching for social change and chose student teaching placements in schools that were predominantly Latinx, low SES, and had academic patterns of chronic underachievement. This transition away from schools with patterns of high achievement was a challenging one and the sense she made of it as she encountered learners that were very different from her reified deficit framings and didactic approaches. She associated the students' academic challenges with their cultural background, which was different from her own. She discerned that to be the teacher she hoped to be (fun, good relationships with students, and academically challenging) she would need to be in a more diverse school. Diverse read here as heterogenous. Her ideal site would have more of an abundance of students with whom she shared a culture or sociohistorical background.

So, while their own schooling experiences and how they framed their teaching hopes were quite different, Carmen and Tanya wound up with very similar perspectives on students. Good math learners are those that are like them. For Carmen this was embodied in English learners who were self-motivated, self-sufficient, and

academically successful. While Tanya, who began the MA/C program with a vision of teaching for social change found that while all students could learn, it was only students like her (academically and culturally) that could do so in collaborative, student-centered, environments. Both tended towards control-oriented modes of classroom management and didactic teaching.

Pierce, like the others, also brought assumptions about students that were rooted in the perspectives he had about himself as a math learner to the study and practice of math teaching. However, his narrative was quite different from his peers. Although successful in math, he was not always motivated to do well in the subject. Referring to himself at times as a lazy student, he wondered if his own competence in math was innate or constructed through schooling. He was aware that at least part of his success in math was the result of having access to 'better' teachers, some of whom used collaborative and process-based approaches to teaching. As he came to learn more about teaching and learning, he reflected on his own experiences as a student with a new awareness that these pedagogical choices were significant in supporting his learning.

He brought this understanding of himself as a student to the sites where he interned and later taught. For him, good math learners were not innately competent in the subject, they did not have to love it or demonstrate high levels of motivation, they merely had to show up and try. Much like Carmen and Tanya, when he began internships through Teach STEM, Pierce also sought schools that were similar to his own. His focus became that of engaging students to learn and for this he anticipated

that everyone in the class had that potential to learn. For his time in Teach STEM this meant that he prioritized methods of teaching that would allow more students to engage. Even as didactic approaches felt easier and more comfortable, based again on many of his own student experiences, he challenged himself to try out activities and participation structures that were more aligned with the collaborative, process-based pedagogies that he found he preferred as a student.

Linear and insulated path.

Echoing Lortie's work on the apprenticeship of observation, Feiman-Nemser and Remillard (1995) pointed out that "[l]earning to teach is not synonymous with teacher education. Teacher educators intervene in a process that begins long before teachers take their first education course" (pp. 2-3). The candidates for this research are unique in their preparation because they participated in Teach STEM. Teach STEM used financial incentives and access to middle and high school math classrooms as a recruitment strategy. A focus on career preview, with financial supports, was the draw to the profession. The program's focus on recruitment meant that the goal was to draw students in, not to disrupt those their incoming conceptions of math teaching and learning or of themselves as math teachers.

These internships gave students access to classrooms sooner than they might have had otherwise and extended their career preview time. This approach to recruitment mimicked teacher preparation as the internships shared some features with student teaching. Students had sustained engagement with classes and received direction and support from the teacher of record. There was an affiliated course where

students discussed their field placements; they also had the opportunity to take additional courses in education on one of three pathways: 1) through the STEM education minor housed in the natural science division, 2) through the education minor housed in the social sciences division, or 3) taking courses in education without completing either minor.

However, it differed because unlike teacher preparation which tends to be a clear path with set course and, at least in California, an assigned teaching supervisor, the program was largely self-determined. Keeping the focus on recruitment, rather than preparation, the program was structured to give students a great deal of choice. While participation in internships was incentivized financially, students receiving incrementally more for each internship, the associated coursework was not. This approach was coupled with financial and application support to prepare to apply to the MA/C program. Although they were not formally connected, participation in Teach STEM was perceived as a clear pathway to the program at Cliff. While participation in Teach STEM did not result in easy entry, the experience and supports provided were a form of eased entry.

Among the candidates that are the focus of this research, each chose different paths through Teach STEM. This meant that they essentially created their own pre-professional pathway. The strength possible in self-direction in terms of recruiting and defining potential areas of interest as a teacher was also a concern given the calcification of their perspectives that occurred through the Teach STEM experience. Pierce completed three internships and the STEM education minor; he developed a

strong interest in sociocultural theories of learning and focused his courses on those that prioritized theories and methods of teaching. Carmen also completed three internships and the STEM education minor; she developed a strong interest in multiculturalism and diversity in education and focused on courses about the social and racialized contexts of schooling. Tanya joined a year later and completed two internships; she did not take courses focused on education.

Another complexity that emerged was that the candidates were able to pick the types of schools where they completed internships. For these candidates, each of them chose schools with demographics similar to those they attended as students and similar patterns of academic achievement. Again, while the ability to choose sites was a powerful recruitment strategy, it also meant that the field experiences largely did not provide opportunities to disrupt their incoming conceptions about teaching and learning and of themselves as future math teachers. This effect was sustained through the program design which put students in placements without outside supervision. So, what they did in the placement (e.g. the degree to which they engaged or taught) was determined largely by the placement teacher. This flexible approach enabled classroom teachers to engage with minimal distraction to their work life as they could position the students as observers or assistants.

There were some parallels between the placement process for Teach STEM and in the MA/C program. While the program was structured differently than Teach STEM, a similar placement strategy was employed where candidates could largely choose the schools (or types of schools) where they would complete student teaching

with the stated intention that all candidates would spend at least one of their placements at a school site deemed 'high need.' However, in contrast to Teach STEM, these experiences were mitigated by coursework intentionally designed to disrupt traditional perspectives on teaching with the support of a content-specific supervisor.

As Lanier and Little (1986) wrote, "The [teacher education] curriculum's easy access and implicit assurances of success provide the opportunity to learn that 'anybody can teach'" (p. 549). This general approach of eased access conflicts with the larger hope for teacher education to disrupt the apprenticeship of observation. Extending from their early experiences in Teach STEM, these three candidates had distinct pathways from their own preparation to Teach STEM to the MA/C program. These pathways tended to calcify their initial conceptions of math teaching.

Cultural match ideologies resulted in generalizations

Another significant finding from this research was the prevalence of the cultural match ideology in the candidates' understandings of themselves as teachers with a specific focus both on who they were qualified to teach and relevant instructional approaches. Generalizations about cultural match between students and teachers emerged, in part through broader understandings of teacher recruitment being focused on augmenting the pool of teachers of color in general and, for both Carmen and Tanya, this was further established in their practice experiences through Teach STEM and the MA/C program.

The guiding assumption was that students of color perform better academically when paired with a teacher who shares their cultural background. These understandings of the value of cultural congruence are well-documented in the empirical literature (Jordan, 1985; Villegas & Lucas, 2002). In part, having access to teachers of color give students examples to strive for. Su (1997) in their research on teachers of color and their perspectives on teaching found a focus on being a role model for youth as a way to encourage academic achievement and debunk existing stereotypes. Another perspective (Ladson-Billings, 1995) is that teachers of color present with unique cultural resources that they can tap to support students. My own collaborative research also supports the idea that people of color are needed in the teacher workforce (Achinstein, Ogawa, Sexton, & Freitas, 2010).

A challenge that these candidates encountered was that culture was presented as a somewhat homogenous construct, as something one has and uses or does not. Implicit in this framing was a troubling tendency towards essentializing one's ethnicity. Culture perceived this way has the tendency to collapse individual difference in light of group commonalities. How Carmen and Tanya specifically came to understand the students that they worked with reflected these simplified ideas around the drive to recruit more teachers of color and those with linguistic resources other than English and had impacts on both who they chose to teach and how.

Carmen confirmed her choice to teach, in part, because of the idea of a cultural match. She understood that her ethnic, linguistic, and familial background could be leveraged to teach Latinx students. Her intention was to teach in the

predominantly Latinx community where she completed her Teach STEM internships and, later, student teaching. Her goal to be a role model and leverage her own background to support students was a laudable one. Her experience in these sites, as an observer and apprentice, did not present modes of instruction or classroom management that could serve to disrupt existing systems of oppression. As Gutierrez (2010) noted, "[f]or identity to be taken seriously, we must also see some analysis with respect to how they are positioned in doing this work, how they position themselves in doing this work, and what meanings they ascribe to the work that they do" (p. 49). Her position in these classrooms often reified the very practices that current reforms were designed to disrupt as part of a more liberatory stance to math education. A faulty assumption often made about teachers of color is that they automatically bring a change agent stance to the work of teaching. In fact, much like their white counterparts, success in the schooling system positions teachers to more often reify the status quo than challenge it.

In Tanya's case, rather than looking to schools as perpetuating systems of oppression or to the pedagogies of the teachers who mentored her, she made assumptions about what students could do and how they could do it based on their collective ethnicities. There were moments throughout her student teaching where she recognized that didactic approaches meant that students had minimal opportunities to understand topics as the focus was often on computations. However, she coupled these observations with a deepening sense that these Latinx students were disenfranchised and could not engage in more complex approaches. She was critical

of their teachers' heavy-handed focus on discipline and stand-and-deliver modes of instruction but, given that the teachers were also Latinx, she made the faulty assumption that these were the modes of instruction and classroom management that Latinx students needed. Given her focus on fun and academic challenge, she found that she was not a cultural match for the students she taught and talked about finding a position at a school with more students that were like her.

Again, Pierce was different. He was aware of the idea of a cultural match and that a focus of recruitment efforts was augmenting the small pool of teachers of color. In fact, he was surprised to learn that he received the STEM Scholars funding because he assumed that the funding was slated towards this aim of more diversity in teaching. However, I found that the line between their conceptions of a cultural match as salient or not lies less in their own ethnic identities and that of their students and more so in their person-focused typologies of teaching. Both Carmen and Tanya assumed that their ethnic identities held a real consequence for their ability to teach students of color; such identities had explanatory power to explain one's fit and success as a teacher, or lack thereof. In Carmen's case, it qualified her for this work and in Tanya's case she felt that it excluded her. In these framings, one's personal qualities become something that you can leverage (or not) to teach such that who you are becomes more important than the work that you do. In both cases, these narrow understandings of identity position teachers as inherently capable or not.

Chapter summary

The schools where they interned during Teach STEM and then later where they completed student teaching (and some were ultimately employed) and those teachers to whom they were assigned tended to hold a significant amount of sway over how they understood themselves as teachers and, consequently, their teacher identity development. All of the teacher candidates reported a strong focus on the field-based learning made available to them through Teach STEM and, later on, the credential program. As Carmen described *"Teach STEM put me back in the classroom… after two years of being with college students and away from what you want to do it gets you further and further away. And then Teach STEM kind of brings you back" (int 1).* The focus here being on the field portion of the program. Another candidate, Tanya, described a strong preference for time in the Teach STEM internships over other university education courses. *"I loved Teach STEM and going into the classrooms and stuff, and I liked the 2-credit class [focused on our internship] we took. But then I took [the courses focused on learning theories] and they were just so boring. Like the classes were so boring."*

Later on, Pierce, who reported enjoying classes focused on learning theories, methods, and social dimensions of schooling also described a strong preference for the practices and perspectives from the field during the credential program:

> *Well it's like, what we've learned in the program so far, um, it helps that, but the only thing that, like all the theories and everything like, you can learn that*

as much as you want, but actually doing it is what, the experience is what I think what makes a better teacher. So, the more experience you have."

It was clear that the students developed stronger connections to the schools where they interned and taught and the cooperating or mentor teachers who supported them. This was neither uncommon nor unexpected. As the candidates prepared for a career that would put them in the field, there is a certain common sense to privileging perspectives from the field over the university. However, as Dewey (1938, p. 25) cautioned, "the belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative." This thread, the focus on practice to the exclusion of the pedagogically focused theories that guide it, is a thread that continued for the candidates throughout the years of the study.

At times, the candidates were highly engaged in the academic offerings through Cliff and brought that to the classrooms where they completed their student teaching, but more so they prioritized relationships with middle and high school faculty, staff, and administrators. The role of finances in general but financial incentives (stipends, scholarship) more specifically are also important here. Not only did the incentives provide an impetus to participate in the programs offered, but the candidates were not only mentored at the sites where they studied, but also hoped to be hired at them (and some of them were) which seemed to further mute the influence of the 'academic' aspects of the credential program as they looked to ways of pleasing the school faculty and administration to prove their worthiness and fit. At

times, this meant discarding their university learning and relationships almost entirely.

Hybrid programs such as the ones that defined the entry context for these candidates have the potential to leverage both practitioner and academic domains. The questions that emerged from this study were not only individually important for the candidates who are the focus of this research but also present programmatic implications for those developing pathways such as this one. The findings from this research can offer, essentially, a revised epistemology of teacher preparation specifically for those candidates who can participate in an undergraduate integrated or parallel teacher preparation or early exposure program.

While Teach STEM solidified the teacher candidates' interest in math teaching, generally, there is evidence that is also solidified their incoming conceptions of math teaching and themselves as math teachers. The focus on practice, often unmitigated by external perspectives (e.g. such that an outside mentor or supervisor could provide) left much of those experiences to be shaped by the students and their classroom mentors. As Britzman (2003) argued and asked,

> once student teachers actually begin teaching, the visions of practice with which they entered are continually being reworked and reinvented. Given this complex instability in a role that still requires authoritative certainty, what does student teaching do to those learning to teach?" (p. 73).

The focus on practice as a draw to teaching as a career, as the site of compensation for engagement, and as the main field for understanding the work of teaching meant that what happened there generally took precedence over other aspects of learning to teach.

Researchers studying the impact of teacher workplace (e.g., Gutiérrez, 2000b; Hargreaves, 1994; Johnson, 1990; Little & McLaughlin, 1993; McLaughlin, Talbert, & Bascia, 1990; Siskin & Little, 1995; Stodolosky & Grossman, 2000) have argued that what teachers do in practice is influenced by not only their own beliefs, knowledge, and experiences but also by the norms and practices of their colleagues.

Specifically in mathematics, researchers have highlighted how the school mathematics tradition and school settings (including colleagues) can undermine a novice teachers' ability to practice teaching in a preferred manner (Cobb,Wood, Yackel, & McNeal, 1992; Gregg, 1995) or to support reform-oriented practice (Stein, Silver, & Smith, 1998). Between Teach STEM and, later, student teaching in the MA/C program, candidates had steady exposure to classrooms and focused on what happened there. Their ability to disrupt deficit-oriented and didactic modes of teaching depended largely on those placement experiences.

Using teacher identity as a theoretical and analytical lens focused attention on the inter-relationships between *who they were* as individuals and the *ways they were shaped* by those contexts in which they participated. Although modes of math teaching are quite durable over time and context, each candidate drew upon different arrays of experience and social positioning to confirm who they would become as teachers. As they made sense of the shared meanings and approaches to teaching in their socially figured worlds of recruitment and preparation, they also actively constructed their own meaning. While the influence of contexts was undeniably strong, the candidates also shaped their teacher identities in unpredictable ways.

Even as Pierce's case is held as an exception, he followed some of the same processes as did Carmen and Tanya. He took his own experiences as a student and used them to inform an analysis of his teachers and frame his expectations for his own teaching. There are some important findings from this cross-case comparison that can guide program development. I address these in the chapter that follows.

Chapter Seven: Research and Practice Implications

This study focuses on teacher identity formation with specific attention to how it is shaped through preservice and early career preparation. Math teacher identity is an identified gap in the empirical literature; this study addresses that gap with a longitudinal focus on math teacher development. Findings focus on the enduring effects of the apprenticeship of observation calcified during the internship portion of the undergraduate STEM teacher recruitment program and generalizations about the utility of cultural match ideologies. The focus on practice, which was largely unexamined and unmentored, reified the candidates' initial perspectives on math teaching and learning. Assumptions about cultural matches, both in terms of who can or should teach whom but also how students from different cultures learn were also reified through a similar process of minimally examined assumptions confirmed through placement experiences. I argue here that future research on math teacher development should engage with identity analytics that are situated and holistic with attention to developing an 'epistemology of practice' that is coherent across recruitment, preparation, and early career programs (c.f. Cook & Brown, 1999).

Consistent with the larger body of research on teacher identity, the candidates' development was complex and non-linear, integrating the candidates' own biographies, experiences with programs that constituted their broader teacher preparation pathway, as well as the middle and high schools they participated in along the way (as students, students of teaching, and later teachers). All three candidates deepened their conceptions of math teaching and themselves as math teachers.

However, despite participation in the same recruitment and preparation programs, who they became as teachers was not predictable.

In the main, their conceptions of teaching and themselves as teachers remained quite durable from the start of their teacher preparation program through the completion of the study. The recruitment, scholarship, and preparation programs formed a kind of hybrid program. I found that Teach STEM, specifically, contributed to calcifying the candidates' early perspectives stemming from their own experiences as students.

The recruitment program, successful in the aim to draw those with a strong math content background to teaching, was not a preparation program. This is an important distinction. The contrast between the Teach STEM and the credential program at Cliff created a tension. This tension influenced the development of the beginning math teachers' identities in various ways and was, at times, sustained by the financial perks and incentives that came from Teach STEM participation. While there were times when the candidates showed deep interest in learning about their practice from multiple perspectives, more often, their attention was singularly focused on the field such that the conceptions of teaching they experimented with were primarily those offered by their cooperating teachers.

The candidates' focus on practice domains, especially in the cases of Carmen and Tanya, focused on replicating traditional norms of math teaching reflected Teach STEM's focus on practice which was minimally mitigated by counter perspectives. This meant that candidates' incoming perspectives (prior to Teach STEM) were more

often reified in the contexts of classrooms rather than challenged. Given this tension, I found that the two central uses of practice in this recruitment-preparation pathway were at odds with one another. Practice was simultaneously the draw to teaching and a site of learning how to teach. However, when presented as a recruitment strategy, it was perceived as teacher preparation. That the candidates were able to choose the contexts where they completed these internships and that these experiences were relatively unmitigated by external feedback or support meant that, as college students, they were often left to make their own sense of these experiences. Practice, then, existed outside of theory and method. This chapter addresses the focus on practice and provides research and practice implications for math teacher recruitment and preparation.

The "Sacred Theory-Practice Story"

"Scholastic knowledge is sometimes regarded as if it were something quite irrelevant to method. When this attitude is even unconsciously assumed, method becomes an external attachment to knowledge of subject matter" (Ball, 2000, p. 241 referring to Dewey).

Clandinin (1995) in the chapter 'Still Learning to Teach' introduced the 'sacred theory-practice' story. This is the long-held assumption in teacher education that candidates first learn propositional theory about teaching and later practice the theory when they are assigned to classrooms as student teachers. Russell and Korthagen in their book *Teachers Who Teach Teachers: Reflections on Teacher Education referred to* Shulman (1986) also noted that "teacher education programs in general seem to be based on the view that teacher candidates will teach effectively

once they have acquired subject matter knowledge, got acquainted with models of innovative curriculum and have practiced using them" (p.188).

Historically, there has been a perceived division between theory and practice in teacher education often made institutionally real by through the symbolic and physical separation of coursework (theory) as a property of the university while fieldwork (practice) resides in K-12 schools. There is often an assumption that the work of these separated sites will somehow be integrated during the candidates' time in the classroom. An underlying assumption of this separation is that the theoretical resides in university course work and the practical resides in school-based placements. Often, teacher educators emphasize the conceptual tools for teaching within coursework and consider school placements as the sites where preservice teachers can enact these concepts through their engagement with specific strategies (Rosaen & Florio-Ruane, 2008).

In her chapter on the importance of theory (here, specifically in feminist theory) to counter patriarchy and white hegemony, bell hooks addressed the theory/practice divide. While not specific to teacher preparation, her argument is an important one.

> By reinforcing the idea that there is a split between theory and practice or by creating such a split, both groups deny the power of liberatory education for critical consciousness, thereby perpetuating conditions that reinforce our collective exploitation and repression (hooks, 1994, p. 69).

Essentially, separating theory and practice or codifying either as unessential limits our opportunities for critical reflection and change. She argued that 'theoretical talk' is the most meaningful when it invites the reader to critical reflection and practice. And,

perhaps more importantly, that theorizing comes from practice and lived experience. This both challenges the theory/practice split that we have become so accustomed to in university settings and elsewhere but also centers practice, taking the view that it is from lived experience that the important theorizing can occur.

I am not arguing in this chapter that this is what happened for the candidates who are the focus of this research through the privileging of practice and practitioner knowledge. However, I am certainly curious about how a similar kind of recruitment, early exposure, credentialing, and even induction pathway could be used to leverage practice in such a way that it is used in tandem with theory for deep reflection and critical change in practices and, ultimately, the contexts where teaching occurs. Such a configuration – an epistemology of practice that is coherent from recruitment to preparation and beyond – may get us closer to a notion of Freirean praxis, "reflection and action directed at the structures to be transformed. The revolutionary effort to transform these structures radically cannot designate its leaders as its *thinkers* and the oppressed as mere *doers*" (Freire, 1970/2018, p. 126).

Smagorinsky, Cook, and Johnson (2003) outlined the assumptions in teacher education about what theory does. These were that theory is something that (1) is put into practice, (2) is put into practitioners, and (3) has an effect on practice. These assumptions guide the development and implementation of many teacher education programs. In line with Clandinin (1995), the organizing principle is that theory or what is also referred to as propositional knowledge is taught first and then applied to

one's developing practice as a student and then beginning teacher. This implies a fairly unidirectional, hierarchical approach to teaching teachers.

Brown and Duguid (2000) in their book *The Social Life of Information* referred to the philosopher Gilbert Ryle who distinguished between 'knowing that' and 'knowing how.' They argued that 'knowing that' involves an accumulation of "data, facts or information. Learning about does not, however, produce the ability to put 'know that' into use… If if did, 'know that' and 'know how' would, in the end be indistingishable" (p. 128). "Knowing how" happens through practice. "And, similarly, through practice we learn to be" (Brown and Duguid, 2000, p. 128).

In the case of teacher preparation, propositional knowledge is a kind of theoretical knowledge that is both developed and taught by university professors. Cochran-Smith and Lytle (1999) referred to this type of knowledge as "knowledge-for-practice" (p. 253). They suggested that the primacy of teaching propositional knowledge is based on the assumption that teaching can develop and improve if candidates have a research-based knowledge about teaching. In short, that knowing 'better' will produce 'better' practice.

Ball and Bass (2000) in their chapter on interweaving content and pedagogy in learning to teach noted the following about this divide:

> the gap between subject matter and pedagogy fragments teacher education by fragmenting teaching… the prevalent conceptualization and organization of teachers' learning tends to splinter practice, and leave to individual teachers the challenge of integrating subject matter knowledge and pedagogy in the contexts of their work. We assume that the integration required to teach is simple and happens in the course of experience. In fact, however, this does not happen easily, and often does not happen at all (pp. 85-86).

Given the long history of math as a gatekeeper subject and the vast inequities in math education, teacher education, broadly considered, has the potential to be an important intervention. This can occur by both expanding candidates' work specifically in terms equity and newer, more process-based, language-rich, and critical approaches to math curriculum. Simultaneously, teacher education has often been viewed as a 'weak intervention' whose effects are 'washed out' by experience learning and teaching in schools (Richardson, 2003; Zeichner and Tabachnik, 1981).

Through the use of grounded theory, this study interrogated this commonly held practice. It provoked questions about what happens when fieldwork is actually the dominant program component, intentionally or not and leads to ideas for further study and program development towards intentional hybrid design. In the following sections, I address implications for research and practice.

Implications for Research

Unlike the broader domain of research on teacher identity, attention to math teacher identity specifically remains a significant gap in the empirical literature. Attending to that gap, this research contributes a theoretical understanding of math teacher identity which offers an alternative to narrow framings of math teachers focused primarily on subject matter mastery (c.f. Grootenboer and Zevenbergen, 2008). Current analyses of math teacher identity have largely focused on individual courses, experiences, or interventions within teacher education (c.f. deFreitas, 2008; Goos, 2005; Nichol & Crespo, 2003). As such, this research also responds to the need to understand teacher development more holistically (c.f. Grossman and McDonald, 2008; Wideen, Mayer-

Smith, & Moon, 1998) by drawing on an ecological and situated framework for understanding teacher development across contexts and over time.

This study began with the proposition that math teacher identity provided a theoretical and analytical framework to study math teacher candidates' entry to teaching, professional development, and career plans which could illuminate the utility of the recruitment and preparation programs in which they participated. By addressing how the candidates responded to these programs and experiences, the focus was less on the enduring questions of quantity and qualifications that guide current recruitment and preparation efforts and more so on questions of quality, distribution, and perspectives of the teachers studied. In this section, I highlight significant findings with attention to areas where more research is needed with attention to (1) placements and supervision, (2) complicating the notion of a cultural match, and (3) expanding research on math teacher identity.

What constitutes placements and supervision?

Given the complexity of practice sites for both recruitment and preparation, more attention is needed to understand what constitutes a placement and how candidates at every level are mentored. Research here should focus on developing what Cook and Brown (1999) referred to as an 'epistemology of practice' that would allow for a bridge from knowing about to knowing how. Applied to teacher recruitment and preparation programs, an analytical focus here can help develop epistemologies that both pass "on knowledge to individuals and creat[e] situations

that help groups develop practices (ways of knowing) that make use of knowledge in new, innovative, and more productive ways" (Cook & Brown, 1999, p. 398).

Research is needed to explore how sites of practice can be leveraged to support a more coherent vision of math teaching. Given the need for coherence from recruitment to practice, how might this line of teacher preparation and development be thoughtfully continued through induction? Research should also focus on policy coherence to support existing recruitment and teacher development goals. I am particularly interested exploring the role of placements in developing a teacher identity in the Integrated Teacher Education Programs (ITEP) which are currently expanding in California in the California State University system with over forty being implemented in the coming academic year.

Complicating the notion of a cultural match between students and teachers.

One of the findings from this research was that without sufficient mentoring or support, the math teacher candidates relied on essentialized notions of culture to determine both (1) their fit with students and (2) pedagogical approaches for students based on cultural generalizations that were both inaccurate and reductive. This mirrors Achinstein and Aguirre (2008) who found that the notion of a cultural match was overly simplistic and did not lead the anticipated change in schools when not coupled with specific support for teachers of color.

Embedded in the cultural match ideology is both a faulty assumption of fit (or lack of fit) based on essentialized notions of race but also generalizations about why people of color enter teaching. As Brown (2014) noted,

> [t]his type of essentializing masks the diversity that likely exists both within and across preservice teachers of color with regards to reasons for becoming a teacher and the perspectives held about teaching and students. This myopic reading limits how teacher educators might more effectively respond to the needs of these teacher candidates (p. 340).

Research is needed complicate the notion of a cultural match in the overlapping contexts of teacher recruitment and preparation. The need to diversify the teaching workforce is well documented (c.f. Achinstein, Ogawa, Sexton & Freitas, 2010). Needed is a deeper understanding of the career trajectories of teachers of color with specific attention to the contexts of recruitment and preparation such that race is addressed non-reductively. Noting that hopes for social change are not sufficient to create change, regardless of one's ethnic or racial identity, research should explore how recruitment and blended programs can leverage their duration to deepen awareness.

Expanding research on math teacher identity.

Given the narrow field of empirical work on math teacher identity, this dissertation serves as an invitation to augment this line of research. Research here should attend both to identity consequences of tensions not only between programs in a preparation pathway but, also, between who one hopes to become as a teacher and their developing perspectives and practices. For math specifically, research should address the larger sociopolitical project of math education. As Gutierrez (2013) noted, "[w]ithout an explicit focus on issues of identity and power, we are unlikely to do more than tinker with the arrangements in school that contribute to the production of

inequities in the lived experiences of learners and educators" (p. 62). Research of this type should not merely document identities but locate those contexts, policies, and practices that support teacher development in the interest of redressing the currently inequitable social arrangements in schools in general and society at large.

Implications for Practice

This section focuses on suggestions for programs like Teach STEM that integrate recruitment goals with pre-professional learning opportunities and related research goals. The focus here is on aspects that might be navigated to create a program that disrupts the apprenticeship of observation. These emerged from the findings for this research. to prevent calcifications of deficit framings and didactic approaches

Placement Coordination and Design.

A central challenge that emerged from this data was the students' selection of their own placement, both in Teach STEM and the MA/C program. It makes sense that, given the opportunity to choose, candidates would select schools like the ones that are familiar to them. However, without an intentional focus on debriefing those experiences with candidates they became sites of reification. As Feiman-Nemser pointed out, there are enduring challenges in the use of field experiences in teacher preparation.

> The culture of teaching and the organization of schools also serve as obstacles to effective field-based teacher preparation. Schools are not organized for teachers to work together on problems of practice in serious and sustained ways. With no tradition of inquiry, collaboration, or experimentation, there is

> a strong press to maintain the status quo. A culture of politeness and consensus makes it hard to confront differences in teaching philosophy and practice (Feiman-Nemser, 2001, p. 1018).

I propose that recruitment and pre-professional programs consider field placements as a primary site of learning about teaching. Given the durability of the conceptions developed during this time, it should be given as much weight as subject matter courses are. This means that financial resources should be focused such that planning and coordination of placements, including support and compensation for mentor teachers, and funding a structure that would allow students to be observed and individually debrief their experiences. This could happen by clustering students at sites so that a supervisor could visit multiple candidates or even debrief with them in small groups at sites.

Intentional Program Design.

Beyond the classroom placements, coursework to support candidates' learning was important. I propose that similar recruitment programs require some coursework along with placement. Essentially, if participation in recruitment programs is shaping candidate perspectives, we should use their time in those experiences thoughtfully. Coordinating intentional placements is one part, supporting those experiences with explicit content is another. In courses or related experience, students should have the opportunity to analyze their own experiences as students, compare that with math education in the main, and tie such learning to specific pedagogical practices that can be used in support of current educational reform. Such content should take into consideration where students are in their development as teachers. Without access to

teaching a whole class, these might preview for them what is possible but should be tied to immediate strategies that they can try. This can include other forms of pedagogical interventions such as analysis of the classrooms where the students are placed. As Ronfeldt and Grossman (2008) suggested,

> novices [could have] more opportunities to observe experienced professionals who embody the alternative images promoted in university coursework while successfully navigating the constraints in today's schools, using both real and virtual classrooms as examples (pp. 57-58).

This means disrupting the idea that such placements have to bounded by a classroom as it can involve observations in multiple sites, as individual or in groups. This can involve virtual observations – of teacher videos found through various educational archives, or of instruction in their placement classrooms, or of themselves teaching.

These strategies can set the stage for future professional learning with an eye towards strategies that disrupt the existing norms of teaching. It can also help debunk the notion that teaching is a personality ran than a set of skills.

Focus on qualities beyond subject matter competence.

Darling-Hammond and Sykes (2003) found that financial incentives, when they privilege candidates' academic achievements and not other important teacher qualities add to the existing staffing issues rather than ameliorate them. They argued that "policy should help induce well-prepared teachers into districts that sorely need them—and enable them to succeed and stay there—while relieving shortages" (p. 4). The candidates for this research understood their subject matter knowledge as unique and leveraged that to define teaching as a potential career. Competence in math

became a primary reason to teach it. This makes sense, that one would teach what they know well. However, unless that is coupled with an explicit focus on the tacit work of teaching, not solely content-specific knowledge, candidates remain focused on content over the people they teach. As Gutierrez (2012) noted in "secondary preservice math teachers think of themselves primarily as "teachers of math" not "teachers of students." (p. 31). Recruitment programs should be explicit in outlining the transition from student of math to teacher of student. This goes beyond one's states goals as a teacher. Individual desire to be a certain kind of teacher requires preparation and explicit supports to do so.

Hybrid programs should be coherent.

Building on Linda Darling-Hammond's (2006) work, I suggest that pathways such as this one be developed with coherence in mind. Housed in separate academic divisions, they engaged with the same schools and local mentor teachers and supporting many of the same students. However, Teach STEM and the MA/C program at Cliff operate as independent programs. This created a kind of mismatch between the programs. Specifically, the goal of augmenting the pool of qualified math teachers is an important one. However, the self-guided nature of Teach STEM was at odds with the MA/C programs specific focus on preparing candidates who would teach in diverse setting with the focus on disrupting existing practices. In many ways the school sites and CTs were more consistent both in terms of messaging and that the candidates had repeated contact with them than the shorter-term, quarter length (ten week) courses. Contact with the same schools and teachers across both programs

meant that the site-specific experiences often took precedence over the courses and focus in the MA/C program at Cliff. Consistency of contact is not the same as coherence.

Sachs (2003) in her work on professional identity that support institutional change argued that

> (1) teacher education should not be owned by the university; it should be recognized that it is the joint property of the university and the profession and (2) restructuring alone is not enough, teacher education faculties have to reconceptualize their place in the professional world and how they operate within that world (p. 57).

Coherence across programs could mean an intentional move towards hybridity, privileging field wisdom in tandem with university knowledge. This is not just a matter of course and field experience sequencing by rather acknowledging the relationships between the different programs and components. It would be an intentional design acknowledging the recruitment program as part of the professional learning continuum and schools as fundamental to that process. Darling-Hammond (2006) found that, without coherence, teacher preparation fails to develop teachers who are change agents.

> Programs that are largely a collection of unrelated courses without a common conception of teaching and learning have been found to be relatively feeble change agents for affecting practice among new teachers (Zeichner & Gore, 1990). Cognitive science affirms that people learn more effectively when ideas are reinforced and connected both in theory and in practice. Although this seems obvious, creating coher- ence has been difficult in teacher

> education because of departmental divides, individualis- tic norms, and the hiring of part-time adjunct instructors in some institutions that have used teacher education as a “cash cow” rather than an investment in our nation’s future (p. 306).

I argue that the same is true of the larger recruitment to practice continuum. The role of induction is also significant in this process.

Appendices

Appendix A: Survey

1. Name:
2. E-mail address:
3. Age:
4. Gender:
5. Race/ethnicity:
6. Language(s) spoken fluently:
7. Degrees held (degree, major, institution):
8. Please describe your overall experience of school (K-college). What kind of student were you? How did teachers treat you?
9. Did you take part in any teacher preparation programs (e.g. Teach STEM) during your time as an undergraduate? Please describe.
10. Describe your previous teaching experience...
11. I chose a career in teaching because [at least TWO or THREE reasons]...
12. I want to teach this subject matter in particular because...
13. I expect the hardest thing about being a teacher will be...
14. I expect the easiest thing about being a teacher will be...
15. I expect the most enjoyable thing about being a teacher will be...
16. I expect the least enjoyable thing about being a teacher will be...
17. If I had to compare teaching to another profession it would be _____, because …

18. I expect my greatest attribute in teaching to be…
19. I expect my most troubling attribute in teaching to be...
20. Ideally, the kind of teaching situation I hope to find after this year is the following (please include grade, type of school, type of community, general or actual location)...
21. One thing I know I'll need to work on this year is ...
22. Above all, a good teacher possess these 5 traits...
23. Three of the most pressing problems in education today are...
24. Two reasons I chose the (insert name) credential/Master's program...
25. My favorite teacher (K-College) was _____, because...
26. My least favorite teacher (K-college) was _____, because ...
27. My hopes for this year include (at least three things):
28. I learn best when...
29. My questions or concerns about this year are (at least two or three)...
30. One or more personal experiences that have prepared me to become a teacher...
31. Any comments, questions, notes for Dena...

Appendix B: Interview Protocols

Interview Protocol #1 (Fall, Teacher Preparation Year).

Goals for this interview:

- First time meeting – **introduce, discuss what each of us will do, schedule next time to meet and, if possible classroom observation**
- Topics to cover: reasons for entry into teaching, program selection, prior schooling, practice experiences, conceptions of teaching, anticipated career plans
- Activities: review anything pertinent from the survey, card sort

1. *Reasons for Entry*
    a. Tell me the story of how you decided to become a teacher.
    b. Were you encouraged/discouraged to enter teaching?
    c. Did you consider other careers? Which ones?
    d. Do you have teachers in your family? Or know anyone who is a teacher?
    e. Why elementary school?
    f. Where do you hope to teach when you finish the program(location, type of school, general demographics)? Why?
    g. Did you work with students before the credential program? What did you do? What others kinds of work did you do before entering this program?
2. *Prior schooling*
    a. Where did you attend elementary school? High school? College?
    b. Describe your experiences as a student
    c. Did you have a favorite teacher? Describe her/him

3. *Program selection*

    a. Why did you choose this credential program?

    b. Which other programs did you consider?

Review anything that came up from the survey

Card sort – using students' terms – to describe conceptions of teachers and teaching

Card sort: Here are some cards with terms that have different understandings of teachers and teaching. Look through them and sort them according to how you understand teaching. There may be some that don't fit - you can separate those out, but we will still talk about them … Now talk to me about how you sorted them. Why do you see it this way? Give examples of how you see (or don't see) yourself enacting these. Was there anything missing here? What would you have added?

Interview Protocol #2 (Winter, Teacher Preparation Year).

Goals for this interview:

- Topics to cover: catch up (program, placement, other); talk about observation
- Anything important that came up in last interview
- Activities: concept map

Catch up

1. Catch me up with what you are doing: placement, university courses.
    a) Courses
        i) Which classes are you taking?
        ii) What is going well? What might you need more of?
        iii) Peers – finding other people who share common teaching interests/goals? Interests outside of teaching?
        iv) Faculty
    b) Placement:
        i) Any updates (e.g. changed placement, etc.)
        ii) What are you doing in your placement? What aspects of instruction are you responsible for? Outside of instruction, what else are you doing in the new classroom?
        iii) Working relationship with cooperating/mentor teacher.
        iv) What seems to be working well there? What doesn't seem to work?
        v) Has anything surprised you?

vi) What is going well for you as a teacher? What struggles are you facing? How are you working through these? [i.e. who do you go to for support? (be sure to delineate what this means); what resources (print, online, course-related) do you rely on?]

c) Outside of univ/placement:

i) Anyone else that you talk about teaching with?

ii) What other kinds of things do you do outside of school?

d) How are you feeling about becoming a teacher? What is sustaining your interest and motivation? What concerns do you have? What do you feel hopeful about?

e) Review classroom observation; For example, if s/he taught a lesson then ask:

i) How did you decide what needed to be taught?

ii) What/who did you rely on to understand how to teach this?

iii) Talk me through how you designed the lesson and prepared to teach it

iv) Describe how you thought the lesson went

v) How did you feel while you were teaching?

2. Anything important from last interview
3. **Concept map** to locate (from interview and new ideas) the sources that they draw from to inform their teaching
4. Anything else you want to talk about?

Interview Protocol #3 (Spring, Teacher Preparation Year).

TEACHING

1. Define teaching. What makes a good teacher? What are qualities you associate with bad teaching? What are qualities you associate with good teaching? What makes *you*, specifically, a good teacher?
2. What parts of your personality serve you well as a teacher? Which parts work against you?
3. Are their conscious ways you alter your personality when you're teaching?
4. Can you think of other areas of your life, of your world, that have had influence on how you teach or how you think about teaching and learning?
5. Tell me about a few of the mistakes you've made.
6. What do you think is the hardest thing about teaching?
7. Are there any presumptions about teaching you had before that have since been shattered?
8. Beyond instruction, how do you see your role as a teacher?
9. Where do you get your teaching ideas? Where do they come from?
10. Do you find that you have lots and lots of teaching ideas or do you have to sort of struggle to pull them out of your head or from other sources?
11. What are some great teaching practices you've seen recently? What are some awful ones?
12. What makes a good learner? What kind of student do you think is the easiest for you to teach? Why? What kind is the hardest?

TEACHER EDUCATION

13. How do you define “theory”? How do you define “practice”?

14. What role should theory play in teacher preparation? What’s its role in your t. ed program? How is it helpful? Give examples.

15. What role should concrete, “tricks of the trade” play in teacher preparation? What’s their role in your t. ed program? How is it helpful? Give examples.

16. Do you see any conflict between theory and practice? Talk about this.

17. Are you getting enough theory? Too much? Enough concrete strategies? Too much?

18. What does a math teacher need to know?

19. How valuable has the coursework been? What have you learned?

20. Do you learn things from your program colleagues? Who? How does that happen?

21. Is there any competition amongst the [program] group?

22. Does the school climate have an effect on you? (Is it socializing you?)

FINANCIAL INCENTIVES

23. Think back to when you entered Teach STEM. Why did you want to do it? What parts did you appreciate the most? If you could change something about it, what would it be? What was the role of the stipend in entering Teach STEM?

24. Think back to when you were applying to the credential program. How helpful was the STEM Scholars money in making the decision to come? Do you think you would have come otherwise? Why or why not?

CAREER PLANS

25. What compels you about teaching? What concerns do you have?

26. Immediate career plans? (Probe for interviewing, etc.,). 2 years. 5 years. 10 years.

Interview Protocol #4 (1st year of teaching, beginning of the year).

General

1) Before we get to specifics, tell me about your experience of teaching so far.

2) In what ways is teaching living up to your expectations?

3) What have been the surprises?

4) Looking back to your preparation program and even Teach STEM, what aspects of the program prepared you for the classroom? Are there things you feel unprepared for? Hiring (revise if hiring story was covered in the last interview and just recap)

5) We want to understand how teachers come to teach in particular schools. Can you tell me the story of how you came to take a position here beginning with how you found out about the job and ending with the interview process and job offer.

a) What other positions did you interview for?

b) Did you receive other offers?

c) Which were you considering?

d) Tell me about the offers you declined. What went into your decision to decline the offer?

e) To what extent was salary a consideration?

6) What attracted you to this school, in particular? What went into your decision to accept a teaching position here?

School Conditions

7) What did you know about the school and this position before you began teaching here?

8) What is your assignment? Walk me through the classes you teach.

9) What curriculum do you use? What resources are available?

10) Who else teaches these classes? What are the opportunities for collaboration?

11) Besides teaching your classes, what other responsibilities do you have?

a) How do you feel about what's expected of you at this school? Does it seem reasonable?

12) Workload is often an issue for beginning teachers. I'd like to have a sense of how many hours you put in a day outside of your regular teaching day. Walk me through what happens after the bell rings on a typical day. How much time do you put in on the weekend and what kinds of work do you do?

13) Department's often have norms or a particular "culture." What's your impression of the [math/science] department here?

a) How often do you meet? What do you do during department meetings?

b) Do you have a sense of whether or not the department is a good fit with your teaching style?

14) Please describe the types of support you've received as a new teacher.

a) Administrative support?

b) Do you have a mentor or a coach?

c) Are you part of a formal induction program? Describe what you do as part of your

induction program.

d) Where do you go for information or advice about what or how to teach?

e) Is their particular support you've needed that you have not received?

STEM Scholars

1st Year: Beginning of the Year

15) Tell me about the evaluation process?

a) Who evaluates new teachers at the school?

b) What kind of feedback did you receive? How was it useful to you as a new teacher?

c) What happens next in the evaluation process?

16) Imagine I were a colleague and I was looking for a job, what would you tell me were the pros and cons of teaching here?

Wrap-up

1) Have you questioned your decision to be a teacher?

2) Have you questioned your decision to teach at this school?

3) As you know I am studying the experiences of new teachers and the conditions that support them. Can you think of anything that will help me understand your experiences as new teacher?

Interview Protocol #5 (Year 1 of teaching, end of year).

The first set of questions is about your general impressions about teaching at the end of your first year.

1) Now that you have finished your first year, tell me what you think it takes to be a good teacher?

2) Tell me about your successes this year.

3) What have you found challenging?

4) Are there any general comments at the end of your first year about being a teacher?

Now I am going to ask you a few questions about how you came to teach at this school and the interview and hiring process. We went over this at the end of last year so it will be brief.

5) Walk me through the process of being hired here starting with the interview process and ending with accepting the position.

6) What were you looking for in a school when you accepted your first teaching position at this school. Do you feel like you found what you were hoping for? Did you consider changing schools? (prompt for when, what happened, job search).

7) Walk me through the decision-making process for choosing to stay at this school (or deciding to leave). (If changing schools, ask about the job search/selection/hiring process).

Now we are going to talk about teaching at this school. Some of these questions are repeated form the beginning of the year but I want to ask them again now that you have taught at the school for a full year.

1) Imagine I were a first year teacher and I were applying for a teaching job here, what would you tell me were the pros and cons of being a beginning teacher here.

2) Tell me about your teaching assignment this year. What classes did you teach?

3) What resources and support did you have for teaching these classes?

4) How was the assignment a good match for your skills and abilities?

5) Do you know which classes you'll teach next year? Are you happy with your assignment?

6) Have you participated in a formal induction program? Tell me about the kinds of things you do with your mentor. (prompt for coaching? observing teachers and debriefing? instructional support?)

7) What advice would you give a principal on how to support beginning teachers at this school?

The next set of questions are about your department.

8) Departments often have a particular culture or agreements for how people work together. Tell me about the (math, science) department at this school.

9) How often do you meet? What do you do together? Describe a typical department meeting.

10) How do you feel the department is a good fit for you?

I have some questions about the administration and evaluation process.

11) Describe the role the principal takes at this school. What is his/her leadership style?

12) Tell me the story of a time you felt well supported by your principal. How about a time you felt unsupported?

13) Walk me through the process of how you were evaluated this year. (prompt for time-lines, evaluator, feedback).

STEM Scholars

14) What happened after the evaluations? What kind of follow-up was there from administration? Was the feedback consistent with what you saw as the strengths and weaknesses with your teaching? How did it compare with feedback you have gotten from your mentor or coach?

15) What is your sense of how satisfied administration is with your teaching?

My last questions are about your future plans.

16) Do you have any doubts about choosing teaching as a career? What about choosing this school as a workplace?

17) Where do you see yourself in five years? Ten Years?

18) What are your plans for the summer?

19) Is there anything you have to add that I didn't ask about?

Interview Protocol #6 (Year two of teaching end of year).

Note: Throughout the interview, probe for comparisons between (a) expectations and actual experience, (b) this and prior year(s), and (c) current and prior school(s).

Thanks for talking to me today. As you know we are studying the experiences of the STEM Scholars so we can understand more about what is important to new teachers and how the conditions at their schools support their work. I'm going to ask you questions about how your second year of teaching compares to your first, what it's like to teach at your school and your plans for the future.

1. What differences have you've noticed about teaching this year as compared to last year.

2. Now that you have finished your 2nd year, can you comment on how well prepared you felt for the realities of the classroom? If you could go back and repeat your preparation program, what would you want to do differently?

3. Did you have any doubts that you would be back at the same school this year? How about for next year? Have you considered changing schools? Have you considered leaving teaching?

4. Walk me through your decision to stay at this school/change schools.

IF MOVING TO ANOTHER SCHOOL ASK ABOUT THE JOB SEARCH PROCESS AND CHOOSING A SCHOOL.

5. How did you go about finding a new school?

6. What were you looking for in a new school?

7. Describe the interview process (prob for offer, acceptance, contract).

8. What went into your decision to accept a position at the school?

9. To what extent was salary an issue?

IF STAYING AT THE SAME SCHOOL ASK ABOUT THE SCHOOL AND EXPERINCES OF FIT.

10. You've been at this school for 2 years and you've accepted a contract for the third year. What makes this a good school for you?

11. What went into your initial decision to accept a teaching position here? Now that you have been here for 2 years, do you have any thoughts about that decision-making process? What went into your decision to remain teaching here?

12. Do you see yourself teaching at this school long-term? What might prompt you to look for another school?

Now we're going to walk through some specific areas about teaching at this school.

13. What is your teaching assignment? Walk me through the classes you teach.

14. How does your teaching assignment compare to last year?

15. In what ways does this school support you in being a great teacher?

16. Are there specific areas the school has not provided support for excellent teaching? Things you think would have made a difference in how successful you have been as a teacher?

17. Imagine I were a colleague and I was considering taking a teaching position at this school. What would you tell me are the pros and cons of working here?

18. Tell me about your department and how teachers work together?

19. Do you have a sense of how well suited your department is with your teaching philosophy or teaching style?

The next questions are about the evaluation process and your assignment for next year.

20. Walk me through the process of how you were evaluated this year. How did it compare to last year?

21. What happened after the evaluations? What kind of follow-up was there from administration? Was the feedback consistent with what you saw as the strengths and weaknesses with your teaching? How did it compare with feedback you have gotten from your mentor or coach?

22. What's your sense of how satisfied your administration is with your teaching? Have there been any problems?

23. Were you rehired for next year? When did you receive this notice?

24. What do you know about your teaching position for next year? (prompt for change of assignment).

25. Describe an ideal scenario in terms of your position and teaching assignment for next year.

We're going to wrap up with your plans for next year.

26. Everyone has the odd bad day (or even bad week) and wonders why on earth they are doing this but have you doubted your decision to become a teacher in a

substantive way? In other words, have you thought that perhaps teaching was not a good choice of careers after all?

27. What are your plans for the summer?

28. What are your plans for next year? (if moving, probe for what they have done to change schools and what kind of school they are looking for).

29. How long do you plan on staying in teaching? (prompt for future plans – admin?)

Interview Protocol #7 (Year five follow up interview).

We are very interested in how teachers choose schools so I am going to ask you some questions about how you came to teach at your current school.

4) When you were looking for a teaching position, what were the things you were looking for in a school?

5) Were there any deal breakers – things you absolutely did or did not want in a school?

6) To what extent was salary a factor in the decision making process?

7) Did you interview for other positions?

8) (If yes) Were you made any other offers

9) Fill me in on how you came to teach here. What attracted you to this school, in particular?

10) How did you know there was an opening at the school?

11) Please describe the hiring process? (prompt for interview, job preview).

12) What's your sense of what this school looks for in a teacher?

Now we're going to transition and talk about what it is like to teach at this school.

13) Let's start with your teaching assignment. What classes do you teach?

14) Tell me about the curriculum you use. Is it required? What resources do you have to teach your classes?

15) Some teachers feel micromanaged in terms of their curriculum and some feel like there aren't enough resources and they have to create everything. Where would

you land on this spectrum? How happy are you with the curriculum and resources you have available?

16) Where's the school in terms of Common Core alignment? Has that proved challenging to you as a relatively new teacher?

17) Who else teaches these classes? What are the opportunities for collaboration?

18) Besides teaching your classes, what other responsibilities do you have?

19) How do you feel about what's expected of you at this school? Does it seem reasonable?

20) Workload is often an issue for teachers. Can you give me a sense of how much you work outside your regular teaching day?

21) Tell me about your department. What's the [math, science] department at your school like?

General Follow-up

22) How often do you meet? What do you do during department meetings?\

23) What's the make-up of the department – mostly newer teachers? Mostly veterans? A mix?

24) How well do people work together?

25) Do you have a sense of whether or not the department is a good fit with your teaching style?

The next set of questions are about induction and new teacher support (for teachers in their first 2 years of teaching).

26) Did you go through/are you in a formal induction program? How's that going?

27) Tell me about your mentor? Who is s/he? How often do you/did you meet? What kinds of activities did you do together? (prob for content area? On-site?)

28) Is their particular support you've needed that you have not received?

Now we are going to talk about evaluation.

29) How have you been evaluated? (if not yet the - how will you be evaluated?)

30) Describe the feedback you received through the evaluation process? Was it useful to you as a teacher? Did it support your professional growth?

31) Was your contract renewed every year? Was there ever a question of whether or not you were going to be rehired?

32) IF NON-REELECT Tell me the story of finding out you were not reelected. (prob for content on evals; reason for non re-elect, resigned to avoid the non-reelect).

33) What is the process for becoming tenured in this district? Were you (or do you anticipate being) granted tenure?

34) Imagine I were a colleague and I was looking for a job, what would you tell me were the pros and cons of teaching here?

[Wrap-up]

35) As I mentioned at the beginning of the interview, we are interested in understanding what attracts teachers to particular schools and what influences their decision to remain teaching. Is there anything you would like to add about your decision to teach at this school?

36) What do you see yourself doing next year? What's your five-year plan?

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