This is to certify that the
dissertation entitled

STORIES OF CHANGE: NARRATIVE PERSPECTIVES ON ELEMENTARY TEACHERS' IDENTIFYING AND IMPLEMENTATION OF NEW MATHEMATICS TEACHING PRACTICES

presented by

JOY ANN OSLUND

has been accepted towards fulfillment
of the requirements for the

Ph.D. degree in Teacher Education

Major Professor's Signature

May 14/2009

Date

STORIES OF CHANGE: NARRATIVE PERSPECTIVES ON ELEMENTARY TEACHERS' IDENTIFYING AND IMPLEMENTATION OF NEW MATHEMATICS TEACHING PRACTICES

By

Joy Ann Oslund

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Teacher Education

2009

ABSTRACT

STORIES OF CHANGE: A NARRATIVE PERSPECTIVE ON ELEMENTARY TEACHERS' IDENTIFYING AND IMPLEMENTATION OF NEW MATHEMATICS PRACTICES

By

Joy Ann Oslund

Recent mathematics education reforms (NCTM, 2000) have resulted in increased opportunities for teachers to learn new teaching practices. However, the relationship between teacher professional development and the actual implementation of new practices is unclear. I posit that a teachers' decision to implement newly learned practices is strongly connected to her identity. However, the relationship between experienced teachers' implementing of new practices and their ways of identifying has been largely ignored.

How teachers learn to implement mathematics pedagogies that promote equitable student outcomes is a particular concern. Complex Instruction (CI), one such pedagogy, is a set of principles and practices for organizing cooperative group work in heterogeneous classrooms (Cohen, 1994; Cohen & Lotan, 1997). In this dissertation, I report on four elementary teachers who chose to implement CI. Building on theories that link learning, practice, and identifying (e.g. Wenger, 1989), I analyze the identifying stories of the teachers using tools from narrative analysis (e.g. Gee, 1991; Labov, 1972) in order to understand how identifying and change in teaching practice impact each other. I elicited narratives in three contexts: individual interviews about CI lessons, group discussions, and presentations about CI to other teachers.

This study explores how teachers come to identify as new kinds of teachers while implementing new practices and how those ways of identifying become reasons for the teachers to continue those practices. Teachers identified as CI mathematics teachers by reifying narratives of their CI mathematics teaching experiences and integrating them into existing identifying narratives or negotiating between new narratives and existing narratives.

This study provides a language for the difficulties inherent in teacher learning (i.e., implementation of new practices) that is respectful of teacher knowledge and experience. The explication of the impact of mathematics education reforms on teachers' lives and practice has implications for policy and professional development.

To

Hannah and Lena, who motivated me;

Dave, who supported me;

and I AM, who inspired me.

Thank you.

ACKNOWLEDGMENTS

"No one of us alone is as smart as all of us together." This is a guiding principle in Complex Instruction. Truly, this dissertation would not be what it is without the *smartnesses* of many people who provided support, read drafts, suggested ideas, and inspired my writing.

I especially want to thank my advisor and dissertation director, Sandra Crespo, who read countless drafts and encouraged my creativity. Thanks also to the rest of my committee, Helen Featherstone, Ralph Putnam, Anna Sfard, and Dorinda Carter. Each of you pushed and encouraged me in important ways.

My weekly meetings with Ann Lawrence and Deb VanDuinen were indispensable to my completion of this project. I am deeply grateful for the constancy of wisdom and friendship.

This dissertation would not have been possible without my CI colleagues. I am deeply thankful that Lisa Jilk brought CI to Michigan State University and that Marcy Wood and Helen Featherstone worked with her to bring it to local teachers and interns. The CI week in the summer of 2006 was a turning point in the story of my development as a teacher and scholar. My deepest gratitude also goes to the CI teachers who let me into their practice and their lives. You have inspired me with your ingenuity, dedication, and energy.

To my second- and sixth- grade students and colleagues in the Negaunee Public Schools: the joys and sorrows of our daily work inspired and motivated me throughout

my Masters and Doctoral studies. I am so thankful to have spent eight years teaching in the best place in the world.

To Jeremy Dowsett, especially for your time and energy with edits. But you and the rest of Blacksoil have also been essential to the integration of my spiritual and scholarly identities. Thanks also to my neighborhood group: Julie, Dave, Irene, Bruce, Brigette, and Kim. My weekly dinners with you have sustained my emotional, spiritual, and intellectual energy in a way that nothing else possibly could have.

To my parents, Duane and Rita Palomaki: You both demonstrated a passion for equity and inclusion in education that has impacted my life story. Your constant prayers were effective. Thank you is too small a phrase to next to the immensity of your impact.

Hannah, Lena, and Dave, I have not forgotten you, but have chosen to save the most important people in my life for last. You have given so much; this dissertation is yours as much as it is mine. Hannah and Lena, watching you grow and learn has been more inspiring to me than any class I have taken or any book I have read. You are geniuses! Dave, you have partnered with me in this endeavor in every way. Your faith and love have kept me going.

Above all, thanks to God, the first I AM statement and author of the narrative that changed my life.

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CHAPTER 1: INTRODUCTION

In 1991, I graduated from high school and left my childhood home in the rural Upper Peninsula (U.P.) of Michigan to study at a university in a wealthy suburban area. For the first years, I struggled to feel like I belonged with my classmates, many of whom had grown up in the area around the university. I spoke differently (folks from the U.P., or "Yoopers" as we are colloquially called, often have an accent that others describe as almost Canadian, but not quite), dressed differently (fashions take longer to reach the U.P., where places to buy clothes are fewer), and struggled to understand my peers' assumptions about their suburban lifestyles.

As hard as it was to leave the U.P., it was even harder to return, because I had changed while I was away. After graduating from the University and teaching for a semester in a suburban elementary school, I was offered and accepted a position at an elementary school near where I had grown up. I was relieved to be going home. I expected to be received as an insider. And yet, people pointed out that I spoke differently and dressed differently. Several of my students' parents distrusted me from the start. They perceived that I was trying to impose my big-city (progressive) ideas about education on them.

This impacted my perception of my role as a teacher. A particularly memorable moment in my early teaching stands out as one that shaped my identity. A second-grade student had been talking about how he did not plan to continue school any longer than legally required; after all, his parents were doing well without degrees. As I launched into a speech about the importance of education both for economics and for life, it hit me. By inviting my students to become "school people," I was possibly asking them to

experience the same heartache I was experiencing. I could be inviting them to participate in an activity that could potentially change how they participated with their families and community. I was asking them to change themselves.

This narrative is my own; however, there are older narratives with similar plots told by other storytellers. W.E.B. DuBois, in the story, "Of the Coming of John" (1994/1903), wove the tale of a young African-American man who, in the early 1900's, left his village in the south for a schooling in the north. Early in his time at school, John had trouble adapting to the norms and expectations of the academy. W.E.B. DuBois writes about John's troubles when he first arrived at school:

> Up in Johnstown, at the Institute, we were long puzzled at the case of John Jones. For a long time the clay seemed unfit for any sort of moulding. He was loud and boisterous, always laughing and singing, and never able to work consecutively at anything. He did not know how to study; he had no idea of thoroughness; and with his tardiness, carelessness, and appalling good-humor, we were sore perplexed. One night we sat in faculty-meeting, worried and serious; for Jones was in trouble again. This last escapade was too much, and so we solemnly voted "that Jones, on account of repeated disorder and inattention to work, be suspended for the rest of the term" (pp. 143).

After a time, John Jones was allowed to return to school. DuBois describes the changes that ensued:

> Thus he grew in body and soul, and with him his clothes seemed to grow and arrange themselves; coat sleeves got longer, cuffs appeared, and collars got less soiled. Now and then his boots shone, and a new dignity crept into his walk. And we who saw daily a new thoughtfulness growing in his eyes began to expect something of this plodding boy. Thus he passed out of the preparatory school into college, and we who watched him felt four more years of change, which almost transformed the tall, grave man who bowed to us commencement morning. He had left his queer thought-world and come back to a world of motion and of men (pp. 144).

While the changes in John allowed him to succeed in school and allowed his instructors to talk about him as a student from whom they could "expect something," they became a hindrance when John returned to his home community in the south. On the day John arrived home on the train:

> He stepped to the platform, and paused: a little dingy station, a black crowd gaudy and dirty, a half-mile of dilapidated shanties along a straggling ditch of mud. An overwhelming sense of the sordidness and narrowness of it all seized him; he looked in vain for his mother, kissed coldly the tall, strange girl who called him brother, spoke a short, dry word here and there; then, lingering neither for hand-shaking nor gossip, started silently up the street, raising his hat merely to the last eager old aunty, to her open-mouthed astonishment. The people were distinctly bewildered. This silent, cold man, --was this John? Where was his smile and hearty handgrasp? "'Peared kind o' down in the mouf," said the Methodist preacher thoughtfully. "Seemed monstus stuck up," complained a Baptist sister. But the white postmaster from the edge of the crowd expressed the opinion of his folks plainly. "That damn Nigger," said he, as he shouldered the mail and arranged his tobacco, "has gone North and got plum full o' fool notions; but they won't work in Altamaha." And the crowd melted away.

In this story, the changes that John had to make to become a good student were changes that caused him to be distrusted by his community when he returned home. John had changed how he identified, and the community-members perceptions of him changed as well, making for a tragic narrative.

Another story about the impact of schooling on how one identifies and is perceived by others is the 1983 film, *Educating Rita* (Cartlidge & Gilbert, 1983). The film[1] tells the story of a 26-year-old housewife from a working-class family who decided to go to college for the first time. As she studied, she became distant from her husband,

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[1] The film was based on the stage comedy of the same name by British playwright Willy Russell, which premiered in London in 1980.

who did not understand her growing passion for literature and learning. At the narrative's climax, they ultimately divorced.

Why would a person like Rita continue to passionately pursue her schooling, even though it meant losing her husband? In the movie, Rita is depicted as saying to her professor:

> I'm beginning to find me. It's great. It is, you know, Frank? It might sound selfish but all I want for the time being is what I'm findin' inside me...I see [my husband] lookin' at me sometimes. I know what he's thinkin'. I do, you know. He's wonderin' where the girl he married is gone to. He even brings me presents some times, hoping that the presents'll make her come back. It can't. She's gone. And I've taken her place.

Rita is articulating something about how her study of literature is both helping her to discover who she is and also changing who she is. About half way into the movie, there is a scene in which Rita brought an essay to her professor, Frank, to discuss:

> Frank: I don't know what to say.
> Rita: Yeah well try and think of something Frank. I don't mind if you tell me it was rubbish. I don't want pity. Was it rubbish?
> Frank: No, no, it wasn't rubbish. It was a totally honest, passionate account of your reaction to the play.
> Rita: Sentimental you mean.
> Frank: No it was too honest for that. It was almost moving. But in terms of what you're asking me to teach you, in terms of passing examinations, oh, God you see, ah,
> Rita: Say it! Go on. Say it.
> Frank: In those terms, it's worthless. It shouldn't be, but it is. But in it's own terms it's, it's wonderful.
> Rita: It's worthless, you said. And if it's worthless you have got to tell me because if I want to write essays like those on there. I want to learn and pass exams like they do.
> Frank: Yes but, if you're going to write that sort of stuff, you're going to have to change.
> Rita: All right. What, just tell me how to do it.
> Frank: Yes, but I don't know if I want to tell you. I don't know that I want to teach you. What you have already is too valuable.
> Rita: Valuable? What's valuable? The only thing I value is here! Coming here once a week.

Frank: But don't you see. If you're going to write that sort of stuff, pass examinations, you're going to have to suppress, perhaps even abandon altogether, your uniqueness. I'm going to have to change you.
Rita: But don't you realize I want to change. Is this your way of telling me that I can't do it? That I'm not good enough?
Frank: No of course you're good enough. It's not that at all.
Rita: Because if that's what you're trying to tell me, I'll go now.
Frank: No. Rita, I promise you. You are good enough.

In this scene, Frank was articulating what I had intuitively realized when I was teaching my students—that learning results in loss. At times, it may result in the loss of previous paradigms, notions that become outdated, or scientific "facts" that get revised based on a new study. It may sometimes result in the loss of one's previous self-perceptions as one takes on new ways of identifying and changes one's life story.

The changes in Rita were noticeable to others as well. Later in the movie, when Rita encountered her ex-husband and his new wife on the sidewalk, he said of her:

> I believe you're doin' really well at the college now, eh? I hardly recognized you. You really look the part. Doesn't she, eh? Look the real student. You'll be on drugs and demonstration next, ah hah.

Indeed, by the end of the movie Rita was dressing differently, talking differently, responding to her teachers differently, and even identifying by a different name.

Long before DuBois and *Educating Rita*, long before the assumption that education was to be for all people in a democracy, Plato articulated similar ideas in *The Republic* (Reed & Johnson, 2000). He employed the metaphor of emerging from a cave into the sunlight to conceptualize education. He told a story of uneducated people in this dialogue:

> Next, said I, compare our nature in respect of education and its lack to such an experience as this. Picture men dwelling in a sort of subterranean cavern with a long entrance open to the light on its entire width. Conceive them as having their legs and necks fettered from childhood, so that they

> remain in the same spot, able to look forward only, and prevented by the fetters from turning their heads. Picture further the light from a fire burning higher up and at a distance behind them, and between the fire and the prisoners and above them a road along which a low wall has been built, as the exhibitors of puppet shows have partitions before the men themselves, above which they show the puppets.
>
> All that I see, he said.
>
> See also, then, men carrying past the wall implements of all kinds that rise above the wall, and human images and shapes of animals as well, wrought in stone and wood and every material, some of these bearers presumably speaking and other silent.
>
> A strange image you speak of, he said, and strange prisoners.
>
> Like to us, I said. For, to begin with, tell me do you think that these men would have seen anything of themselves or of one another except the shadows cast from the fire on the wall of the cave that fronted them?...And again, would not the same be true of the objects carried past them?...If then they were able to talk to one another, do you not think that they would suppose that in naming the things that they saw they were naming the passing objects? Then in every way such prisoners would deem reality to be nothing else than the shadows of the artificial objects. (p. 11)

Plato's description of uneducated people as naïve and unable to perceive reality is one that is prevalent today. It is not unlike the perceptions of the faculty in "Of the Coming of John," who spoke of John as "unfit for any moulding" because of his exuberance—a very different perception than Frank in *Educating Rita*, who saw the beauty that Rita brought to the world before her schooling. Plato then continued to describe education as emerging from a cave into the light, a painful experience:

> When one was freed from his fetters and compelled to stand up suddenly and turn his head around and walk and to lift up his eyes to the light, and in doing all this felt pain and, because of the dazzle and glitter of the light, was unable to discern the objects whose shadows he formerly saw, what do you suppose would be his answer if someone told him that what he had seen before was all a cheat and an illusion, but that now, being nearer to reality and turned toward more real things, he saw more truly?...And if he were compelled to look at the light itself, would not that pain his eyes...And if, said I, someone should drag him thence by force up the ascent which is rough and steep, and not let him go before he had drawn him out into the light of the sun, do you not think that he would find it painful to be so haled along, and would chafe at it...(p. 12).

In Plato's analogy, students do not willingly learn, but must be dragged by force. Seeing the world as it really is as opposed to the shadows of reality causes pain for the learner. Plato described the experience that would allow this person to see outside of the cave. He then went on to describe the inner changes in the newly educated person that would cause him to pity those who remained in the cave, and eventually return to them to tell them the narrative of what he had learned. However, he would be spoken of as foolish and incompetent by the cave dwellers:

> And consider this also, said I. If such a one should go down again and take his old place would he not get his eyes full of darkness, thus suddenly coming out of the sunlight?
>
> He would indeed.
>
> Now if he should be required to contend with these perpetual prisoners in 'evaluating' these shadows while his vision was still dim and before his eyes were accustomed to the dark—and this time required for habituation would not be very short—would he not provoke laughter, and would it not be said of him that he had returned from his journey aloft with his eyes ruined and that it was not worth while even to attempt the ascent? And if it were possible to lay hands on and to kill the man who tried to release them and lead them up, would they not kill him?
>
> They certainly would, he said (p. 13).

Although I had not yet read Plato's work when I was teaching second grade, I realized that there could be tragic consequences to perceiving my students as "cave-dwellers" in darkness and trying to "drag [them] thence by force up the ascent which is rough and steep." I began to have mixed feelings about my role as a teacher. On the one hand, I saw that choosing not to engage in educational pursuits would limit the choices my students had as adults. On the other hand, I saw that my students and their families, unlike Plato's cave-dwellers, brought something valuable and beautiful to the world, and like Frank in *Educating Rita*, I feared that schooling could destroy it.

Dragging Teachers Up the Ascent

For a long time, mathematics teacher education has been concerned about teachers' knowledge of mathematical content and their beliefs about mathematics, teaching and learning, and students. Of course, there are good reasons to be interested in what teachers need to know and how to help teachers learn these things. Like many others who write about teacher education, my ultimate desire is that students would learn mathematics. Therefore, I am interested in helping teachers know how to teach mathematics to children rigorously and equitably.

However, in speaking and writing about any learners, including teachers, teachers and researchers are faced with a number of choices for metaphors to describe learners. In my teacher education courses, I ask preservice teachers to reflect on whether they view children as empty buckets to be filled or as children who come to class with a complex web of knowledge, experience, and beliefs. In the same way, professional developers have the choice to think about and treat teachers as lacking something important or bringing something important. One way to attend to what teachers bring to these learning environments is for teacher educators to elicit and pay attention to teachers' stories, including their life stories and stories of practice. As seen in the popular accounts summarized in this chapter, narrative is a powerful tool for communicating the impact of life experiences on identity. Unfortunately, both in the mainstream media and teacher education literature contain a plethora of messages that would have people believe that a majority of teachers lack the knowledge and beliefs necessary for effective teaching. By collecting and analyzing teachers' narratives about their teaching experiences, I illuminate

some of the some of the complex work that teachers do as they begin to implement new practices.

Of course, there are teachers in schools who should not be there. However, we need to be careful about how we talk about the goals of teacher professional development, so that we do not, even inadvertently, portray teachers as cave dwellers. It is difficult to change teaching practice. Much has been written about U.S. teachers' lack of content knowledge (e.g. Ma, 1999), and their incapacity to change their teaching practice to align with current recommendations for reform (Cohen, 1990) or their resistance to innovations. And much of the literature assumes that learning is exclusively for creating certain kinds of teachers in order to impact student outcomes. However, Featherstone (2005) argues that this utilitarian view is a "pitfall in the work of teacher education" (p. 135) and that seeing teachers as only a means to an end as opposed to the ends themselves is immoral[2]. One way I view and treat teachers as *ends* instead of as *means* is by adopting narrative methodology, which allows me to listen to the richness of knowledge and experience teachers bring to their practice.

As well, much of the literature assumes that learning is always and only a positive—or at least a neutral—experience for learners. When I became a mathematics teacher educator, I brought with me, based on stories of my elementary teaching experience, a sense of the enormous implications of inviting my students to learn (in this case, learn to teach). These implications are corroborated by the stories of Rita, John, and the cave dwellers. Those who study preservice teacher education are aware of the identity

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[2] In making this argument, Featherstone used Immanuel Kant's argument that it is never moral to regard a human being as a means to an end.

work (the construction of a new identity) involved in the transition from student to teacher (e.g., Britzman, 2003). However, this line of study has not been adequately carried forward into the study professional development of *experienced* teachers. The narratives of experienced teachers who are attempting to become new *kinds* of teachers have not been widely analyzed. I hypothesized that some of the same principles of identity work involved in preservice teachers' transitions from student to teacher would be at play in experienced teachers' transitions from one kind of practitioner to another kind of practitioner. When we ask experienced teachers to continue to learn about mathematics teaching, we are asking them to change their identities in ways similar to those I asked of my rural second-graders.

I hypothesized, however, that teachers' construction of new narrativized identities in professional development (PD) courses would often be subtler and less easy to uncover than it is in preservice teacher education. Our preservice teachers are identifying as teachers for the first time, but experienced teachers in PD already identify as teachers and have many narratives of teaching to tell. However, they identify as certain *kinds* of teachers in those narratives. The performance of new narratives necessary to construct an identity as a new *kind* of teacher is what I was interested in studying. In this dissertation, I do this by analyzing teachers' narratives during a time that they are implementing new principles and practices for mathematics teaching. By analyzing teachers' narratives of teaching to see how they portray themselves in their stories, I gained insight into the kinds of teachers they perceived themselves to be.

At the same time, it is important for all students in K-12 mathematics classrooms to have equitable opportunities to learn and achieve at rigorous mathematics content—

and there are a lot of reasons to believe that this is not currently happening in many classrooms in the U.S. There are a lot of reasons for inequities concerned, and only so much that individual teachers can do to solve these issues. However, firmly believing in the power of an individual teacher to provide rigorous and equitable learning experiences for her students, I wanted to be involved in effective teacher professional development that helped teachers learn to teach in ways that are equitable and rigorous. These are the goals of the professional development course I studied. This is not a simple way of thinking about the purposes of teacher education. On the one hand, I am interested in teachers' learning in and of itself, for the development of teachers as human beings, without simply seeing teachers as the means to an end (in this case, equitable outcomes for students). It is morally imperative to see teachers holistically and be concerned about teachers' experiences and the quality of their lives. At the same time, it is morally imperative to work for equity in K-12 schooling, and a part of this involves teaching new pedagogies to teachers.

Recently, some researchers interested in studying equity in mathematics education have focused on the relationship between identity and learning in mathematics classes. Much of this literature has focused on how students' mathematics identities impact their choices to participate (or not participate) in learning mathematics (e.g. Martin, 2006; Nasir, 2002). The stories I have presented so far in this chapter, however, draw an arrow in the other direction; they theorize that choosing to participate in learning impacts individuals' identities. Therefore, identity may be theorized as a recursive process; learning impacts identity, and identity impacts learning.

In this dissertation, I tell the story of a group experienced elementary teachers who had attended a Professional Development (PD) course in which they had the opportunity to learn principles and practices for teaching mathematics that were new to them. These teachers had come to identify as certain kinds of teachers in their narratives of teaching, and those ways of identifying impacted their perceptions of the recommendations presented in the course and their decisions to implement them (or not). First, I conducted life story interviews of four teachers, two who had decided to implement CI and two who had not, to look for the relationship between their life stories and decisions about CI. Then, over the course of several months, I followed a group of four teachers who told me narratives about their experiences with implementing the principles and practices taught in the PD. I did this in order to study how their identifying narratives about mathematics teaching were impacting their day-to-day learning in and from implementing the new teaching practices and how their learning was impacting their mathematics teaching identities.

John, Rita, the Cave Dwellers, and Me

In this dissertation, I tell the story of a group of teachers who were implementing mathematics teaching practices that were new to them. Their story is parallel to the stories above. The stories of John, Rita, and the Cave are useful in helping to shape and make sense of these teachers' stories. In fact, many teachers use the following structure (Bieda, 2009, based on Hill, 2009):

- Act I: The set up. (Characters and setting are established.)
  - Plot Point 1: A tension or problem
- Act II: The confrontation. (The tension escalates.)

- Plot Point 2: A climax

- Act III: The resolution.

A way to graphically represent this plot structure is shown in Figure 1.

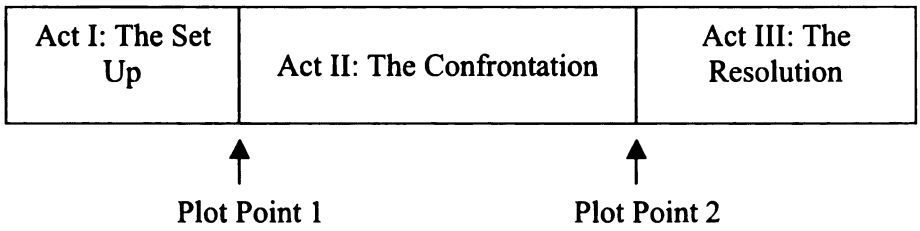

Figure 1: Story Plot Map

The narratives that I summarized in the beginning of this chapter were similar to each other and told parallel stories that might be generally summarized in the same way:

- Act I: The set up. An individual is identified as being a certain type of person.
  - Plot Point 1: The tension or problem. The person experiences some type of dissatisfaction or longing that motivates the person to go to school. (Or, in the case of "The Allegory of the Cave", is forced to become educated.)
- Act II: The confrontation. Schooling. The learner a number of fulfilling learning experiences along with a number of painful experiences resulting from changing identity and relationships.
  - Plot Point 2: The climax. The learner experiences an identity crisis and must decide whether to become a "schooled" person or

continue to relate to family and friends in the ways they did previously to schooling.

- Act III: The resolution. The learner is a changed person. The learner has new ways of being, and has had to come to terms with what has been lost.

A graphic representation of this plot is show in Figure 2.

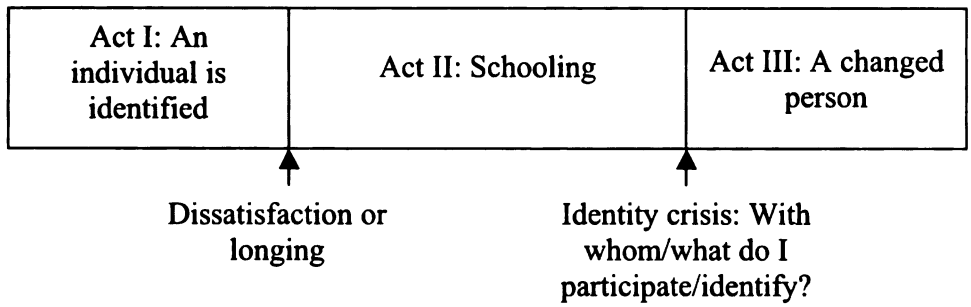

Figure 2. Common Plot of Chapter 1 Stories

The Story of Teachers' Learning

In the remainder of this dissertation, I will tell the stories of a group of teachers who took a Professional Development (PD) course on using Complex Instruction to teach mathematics. Their story is structurally and thematically parallel to the stories above. In terms of the plot structure, the story of these teachers is parallel to the stories in Chapter 1, especially to the stories of John and Rita.

In Chapter 2 I elaborate my theoretical framework. I begin by discussing the history of the problem of teacher learning for equity in mathematics education and for the current mathematics education reform movement. I describe the Professional Development (PD) event that is the context for this study and its connections to those problems. Next, I frame this study within a sociocultural view of learning, describing theories of participationism and situated learning that inform my study design and

analysis. Next, I describe the theories of identity as narrative on which I draw throughout the study. Finally in Chapter 2, I list my research questions.

In Chapter 3 I describe my methods for narrative analysis. I describe the participants, how they were chosen, and the contexts in which they teach. I provide details of the data I collected and the procedures I used to analyze the data.

In Chapters 4, 5, 6, and 7 I present the analysis of the teachers' narratives. The story I tell in these chapters may be graphically represented as in Figure 3.

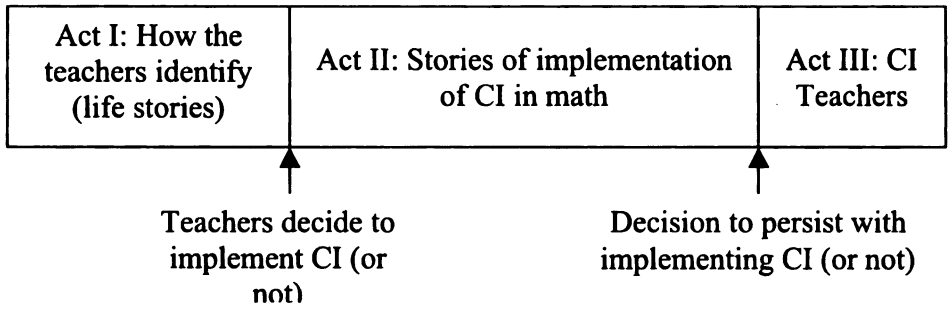

Figure 3. Plot of the Dissertation Story

In Chapter 4 I tell about Act I and Plot Point 1. I report on my analysis of the life stories of four teachers who took the CI course. Two of those teachers told narratives about implementing Complex Instruction after the course and two did not. I analyzed the teachers' life stories, narratives of the CI course, and their discussion of why they did or did not choose to implement CI after the course. I compared what teachers said about who they were at the time of the interview with who they said they were previously. This included both comparing how teachers identified themselves in narratives about their K-12 schooling with how they identified themselves in narratives of their teaching, and how

they identified themselves as teachers before and after the CI course. In this chapter, the teachers' narratives function to propose reasons for deciding to implement CI (or not).

In Chapters 5, 6, and 7 I report on the narratives of four teachers who decided to implement CI. This is a different group of teachers than in Chapter 4, with the exception of one teacher who is in both groups. In Chapter 5 I tell Act II and Plot Point 2 of the story of implementation of CI. I report on their narratives of implementation of Complex Instruction, including a description of the challenges that ensued when implementing CI (Act II) and their reasons for deciding to persist through these challenges (Plot Point 2). In this chapter, I report on my analysis of teachers' narratives, comparing what teachers say about who they are—and more specifically, what kind of teacher they are--with what they say about implementing new practices. The narratives in this chapter function to explicate the identity construction that has to happen for the new practices to become a part of their teaching repertoires.

In Chapter 6 I tell about Act III of the story of teachers implementing CI. After implementing CI for some time, some teachers began to tell narratives identifying themselves as CI teachers, which is the topic of Chapter 6. In this chapter, I theorize about the reification of experience into integrated, expert identities. In this chapter, the narratives function to claim and integrate some new ways of being teachers.

In Chapter 7 I move back to Act I of the story. Specifically, I argue for adopting a view of teachers coming into PD events as bringing valuable competencies with them, instead of adopting a deficit model (or cave-dweller model, as per "The Allegory of the Cave") in teacher PD. In this chapter I move into a micro-discourse analysis of small parts of two teachers' narratives about the same lesson and compare what these two

teachers say about who they are with how they say it. In this chapter, the narratives function to perform knowledge that is (or is not) explicitly recognized by the teacher.

Finally, in Chapter 8 I look across the four findings chapters to answer my research questions. I discuss the implications of my findings, limitations of my study, and directions for future research.

CHAPTER 2: LITERATURE REVIEW

Mathematics Teacher Professional Development, Equity, and Reform

If learning involves loss, then why encourage teachers to continue learning, attending teacher professional development opportunities, and implementing new teaching practices? As the knowledge base of mathematics grows, and as the U.S. moves into a post-industrial economy, there is a great deal of change recommended for both the content and the methodology of mathematics pedagogy. To serve students well, teachers must continue to learn as both doers of math and practitioners of mathematics teaching. The current wave of mathematics education reforms (NCTM, 2000) has brought an increased call for teacher Professional Development (PD) (Ball, 1996).

A particular concern exists for increasing the mathematics achievement of students who have not been well served by traditional mathematics teaching methods. Teachers are confronted with what Ladson-Billings (2006) calls the "education debt," that is, the accumulated effects of inequality in education over the course of our nation's history. Teaching a high level of mathematics to all students is more than an economic issue, it is a moral one. Mathematics is a gatekeeper for many economic opportunities, including higher education. It is also a necessary component of successful participation in democracy (Ball, Goffney, and Bass, 2005). Teaching high levels of mathematics to all children, regardless of race, language, gender, social class or ability, is therefore an issue of economic and social justice.

The link between PD and teacher learning has been studied by assessing changes in knowledge of mathematics for teaching (Hill, Rowan, & Ball, 2005), in students' learning (Fennema, Carpenter, Franke, Levi, Jacobs, Empson, et al., 1996), in teacher beliefs

(Ambrose, Clement, Philipp, & Chauvot, 2004), and in teaching practice (Drake, 2006). Studying these changes separately has been informative; however, it is far from clear what kinds of teacher PD are effective at impacting teacher practice and improved student achievement.

As teacher educators and researchers our challenge is to work toward teacher PD programs that ultimately effect student equity in math education—in ways that honor teachers as ends in themselves and not merely ends to improving student achievement. It would be inconsistent to treat teachers otherwise while simultaneously claiming to be working for equity and justice on behalf of students. Our methods of researching and implementing teacher PD must treat teachers with the same dignity we hope they afford their students.

So in approaching my research questions of what makes for effective PD and effective teacher learning, I wanted to choose a PD program that has been shown to effectively impact the learning of students who have historically been underserved (ex: Boaler, 2006; Gutiérrez, 1999) and which also respected teachers as learners with various identities. *Complex Instruction (CI)* is a PD program that met these criteria. CI is a particular type of cooperative groupwork, used in heterogeneous mathematics classes to promote equitable and rigorous outcomes (Cohen & Lotan, 1997).

Complex Instruction in Mathematics: The Professional Development Context

Mathematics teachers at "Railside" school in California used CI to de-track their high school mathematics courses. The mathematics program at Railside school, which has a high concentration of Latino/a immigrant students and students in poverty, had a positive impact on outcomes such as students' choosing to take upper-level mathematics

classes and going on to colleges and universities (as compared with other schools with similar demographics) (Boaler & Staples, 2005).

CI was developed by Elizabeth Cohen and Rachel Lotan, and had primarily been used in elementary and middle school contexts (Cohen, 1994; Cohen & Lotan, 1997). The teachers at Railside worked with Cohen and Lotan to adapt the principles and practices of CI to the context of high school mathematics. The PD course, entitled *Designing Groupwork in Mathematics*, engaged teachers in learning the specific ways CI had been enacted at Railside school to promote rigor and equity in mathematics. The framework for using CI to teach mathematics that was presented in this PD was organized into three overlapping components: *Curriculum*, *instructional strategies*, and *status*. These are demonstrated in Figure 3 (Teachers Development Group, 2005).

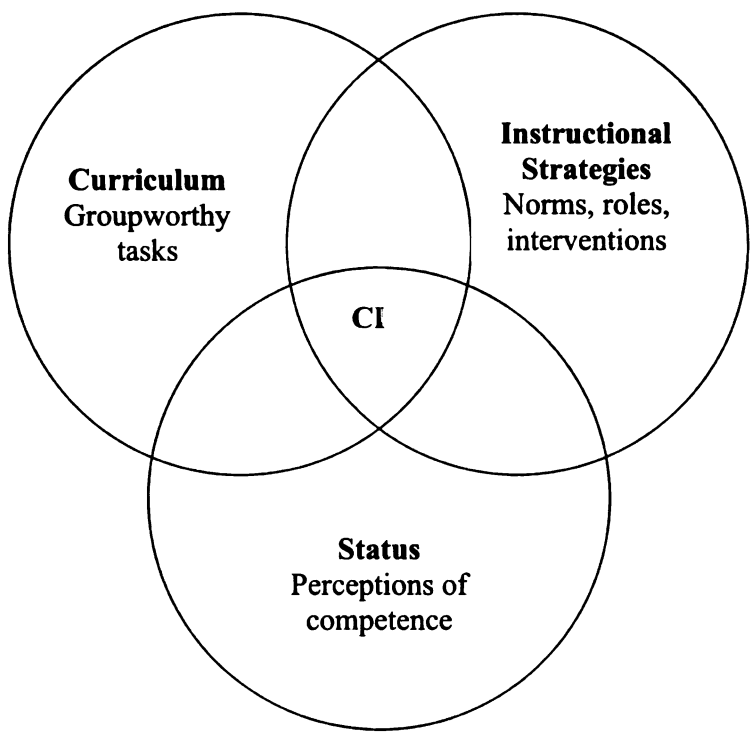

Figure 4: Components of Complex Instruction

Curriculum in CI consists of what are called *groupworthy tasks*, which are mathematics tasks that require a number of different abilities to solve, such that it is very unlikely that any one individual in a group will be able to complete the task without the others. For example, Jonathan developed a task which asked students to solve the problem "15 X 49" in four different ways, and create a poster that demonstrated those four solution methods. Other CI teachers have extended that task so that students also highlight connections between the four solution methods using color, lines, the arrangement of the solutions on the paper, and other visual rhetoric tools. Such a task requires students to construct and use alternative algorithms, find similarities and differences, create and understand a number of representations, organize information, and more (depending on how they choose to solve the problem). Teachers generally give students a one-page task card that explains the task and expectations for the product without being too explicit about the specific steps students should take to solve the task (which can be solved in multiple ways).

Instructional strategies include roles, norms, and interventions. Students are assigned roles, which have been specifically designed to engage them in the mathematics at stake. An example is the *resource monitor*, who makes sure all group members have access to the materials, calls the teacher over for group questions, and is responsible for engaging the group members in clean up. Another role is *facilitator*, who is responsible for making sure that all group members contribute equally to the solution and understand

the work of other group members[3].

Groupwork norms are established that communicate expectations for what it means to do mathematics in groups. For example, some teachers have used the norms, "no one is done until everyone is done," "helping does not mean giving answers," and "group questions only." In addition, a number of interventions are used. Teachers in the PD course spend time learning about how and when to intervene in a group, how to step back and watch a group carefully in order to diagnose status and mathematical issues in the group before intervening, and where to position oneself when choosing to intervene in a group. The purpose of all of these instructional strategies (roles, norms, and interventions) is to promote interdependence among members of a group and autonomy from the teacher.

The third component is *status*. A status issue happens when people in groups rank themselves and each other according to a set of unspoken criteria, and when such a ranking interferes with equal participation in the group (Cohen, 1994). In classrooms, two different types of status are at play: academic status and social status. Status interferes with students' participation in group mathematics tasks because often the students who are perceived as more mathematically competent (have higher academic status) are likely to do much of the work, while the students who are perceived as less competent (have lower status) are likely to allow students with high status to dominate the space, materials, and ideas. This third component is not separate from curriculum and instructional strategies, as both of those components are geared toward disrupting status

[3] Other forms of cooperative learning have used roles; however, CI differs in that every role is specifically engineered to require the individual to engage in the mathematics of the task (not to simply clean up, for example).

in groups and therefore equalizing participation and learning.

In addition to using groupworthy tasks and instructional strategies to disrupt status, teachers attend to status by thinking about the abilities that students bring to math class that may not be traditionally mathematical but may be leveraged for solving mathematical tasks. By building on these abilities (for example, in the multiplication task above, students must use tools from visual rhetoric to communicate mathematical ideas), and by making them explicit to students, teachers help students to see each other as mathematically competent. Over time, such experiences help to disrupt status in the mathematics classroom.

The CI math PD differs from other math teacher PD opportunities in its focus on status. CI takes a comprehensive approach, engaging teachers in all aspects of mathematics teaching, including defining mathematics broadly, rethinking what it means to be "smart" in math, learning to implement instructional interventions, establishing norms and roles for problem solving, and creating rigorous curricular tasks. In other words, they are asked to reframe and rewrite their narratives about mathematics, their students, and themselves as doers of mathematics. CI and creates space for students with many different kinds of identities to participate fully in mathematics classrooms (Jilk, 2007) and has been shown to have profound effects on student learning (Boaler & Staples, 2005; Cohen & Lotan, 1997; Horn, 2005).

The subjects of my study are elementary teachers who chose to attend a 30-hour PD course on using CI given at MSU. I hypothesized that the reason some teachers have committed to changes in practice after this workshop is that it allows many different ways of identifying to happen in the workshop. I studied teachers ways of identifying using

narrative methodology to learn more about this. I note below that their narratives of successful participation in the CI math PD context are resources some of these teachers used to implement CI and sustain these changes in their mathematics teaching practices. But what does sustained implementation of CI in mathematics teaching do to teachers? How does it change their narratives (or not)? And what do the teachers do to change CI (or not) in response? Understanding the implications of learning new practices on teachers is important to respecting teachers and simultaneously promoting equitable outcomes in school .

Teacher Learning Situated in Teaching Practice

A Participationist Lens

Learning may be described as becoming able to participate in or take part in discursive norms and routines of communities of practice (Wenger, 1989). The participationist perspective (Sfard, 1998) posits that learning and participation are thusly related. This theory is often contrasted with what may be called the acquisitionist perspective—an idea that individuals who are lacking some knowledge acquire it from other individuals who impart knowledge to them. While an acquisitionist sees a learner as lacking important knowledge, a participationist acknowledges that, because all participation is linked to learning, all learners bring knowledge, identities, and practices with them. Each learner has a background through which he or she understands and interprets new experiences. Therefore, teachers' narratives of their experiences should be of interest to teacher educator's and researchers interested in teacher learning.

Studies have looked at teachers' learning in and from PD courses, either by measuring teachers' knowledge and beliefs before and after a PD course, or by studying

the fidelity of teachers' implementations to the reformer's intended implementation. One concern that such studies have not fully addressed, however, is that even teachers who want to implement recommendations for reform may not make essential changes and may simply weave some new practices in with their old ways of teaching (Cohen, 1990).

From an acquisitionist standpoint, teachers who attend a PD course should have been given what is needed to fully implement the new practices. In that view, if the new practices are not implemented in the ways the professional developers intended, two reasons are possible: Either, 1) the PD did not adequately disseminate the knowledge, skills, and beliefs that are necessary for implementation, or 2) the teachers did not adequately acquire them.

However, a participationist lens provides more opportunities to look into the dynamics of implementation. A participationist lens focuses attention on the backgrounds that learners bring to a situation—practices, knowledge, and identities—through which learners may interpret new experiences. From this perspective, it is important to listen to teachers' narratives of experience and understand how they interpret those experiences, which I do in this study by adopting analytic methods from narrative research.

An important idea is how learners *reify* participation—that is to translate concrete experiences into abstract objects that have *thing-ness* and are spoken of as existing in ways that physical objects are spoken of as existing. For example, a person who has many experiences in mathematics classrooms may reify those experiences into a statement about her "mathematics ability," assigning the noun "ability" to speak of the idea as an object. Or a teacher who tries to implement a new teaching practice, such as Complex Instruction (CI) may tell a number of narratives about teaching CI lessons.

Eventually she may directly identify herself as "a CI teacher," which is a reification of her experiences with implementing CI. In this study, I analyzed teachers' narratives for the reifications of their experiences.

Learning as Situated in a Particular Context

An idea important to studying learning as participation is *situated learning* (Lave & Wenger, 1991). That learning is situated means that particular meanings are situated in particular contexts. Not only do teachers come to PD events with different backgrounds and experiences, but when they leave the PD course and return to their classrooms to implement the recommendations made in the PD course, they return to different contexts with different students. They have different experiences as they participate in implementing the recommendations. While they are implementing the recommendations and telling narratives of these implementations, they are negotiating different meanings in practice. Simply looking at teachers' implementation, knowledge, or beliefs before and after a professional development intervention therefore gives only a thin slice of the picture of teachers' learning about PD recommendations over time. By analyzing teachers' narratives of practice over a period of several instances of implementation, I give a fuller, more nuanced picture of what it takes to implement new practices and sustain that implementation over time.

In this dissertation, the object of study is the learning of teachers' in their implementation of new practices in their classrooms. There has been a call for increased attention to teachers' learning in and from teaching practice (which is different from teachers' mere experience) (Ball & Cohen, 1999). Teachers' knowledge and practices are linked with the particulars of the contexts in which they occur (Putnam & Borko, 2000).

This dissertation also builds on research that reports on teachers' learning in and from day-to-day interactions in their classrooms (Horn, 2005). Therefore, I studied teachers' narratives of day-to-day classroom interactions, analyzing their narratives for the contexts in which the teachers set them.

Identity

Above, I mentioned that *learning* may be defined as becoming able to participate in a community of practice. Similarly, *identity* may be defined as participation in a community of practice (Wenger, 1998). People identify by choosing to participate in a particular community of practice (such as a club, church, school, or other organization). They tell narratives about their participation, recounting their actions and experiences. And they may reify these experiences into objectified ideas about themselves (such as "I am a kindergarten teacher.") People also identify by non-participation in groups. Additionally, people may identify by affiliating with groups whether or not they physically interact with a particular community of practice (for example, affiliating as a Democrat is participation, although it does not necessarily mean that an individual is participating in activities of the Democratic party).

Participationist views of identity and learning (Lave & Wenger, 1991; Wenger, 1989) imply boundaries between communities of practice, and different positions within communities (such as *legitimate peripheral participation* and *full participation*). Individuals may identify as being a part of a community of practice or not, but also on the periphery or fully participating. This idea of position in a community of practice relates with a notion of identity as positioning (or aligning oneself with some communities, people, and ideas and distancing oneself from others) (vanLangenhove & Harre, 1999).

In analyzing the teachers' narratives, I attended to how their portrayals of themselves positioned them with or against others, such as the students, colleagues, administrators, or the mathematics.

Identifying and Narrative in Figured Worlds

Anthropologists have illuminated the contextualized and recursive nature of identifying stories and actions (Holland, Lachicotte, Skinner, & Cain, 1998). They have defined identities as stories of self-understanding, which have "strong emotional resonance" (Holland, Lachicotte, Skinner, & Cain, 1998, p.3) and are created as "people tell themselves who they are and then try to act as though they are who they say they are" (Holland, Lachicotte, Skinner, & Cain, 1998, p. 3). People improvise identities using the cultural resources available to them. Conflicts between stories, histories, cultures, and situations complicate the work of identifying. Conflicts between different theoretical contexts, or *figured worlds*, are one such complication.

A figured world is "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). Figured worlds may exist within spaces where groups of people actually meet and live, or may exist figuratively in dramatized or narrativized worlds such as books and T.V. Examples of figured worlds are Alcoholics Anonymous or the world of idealized romance. Materials, words, and actions take on different meanings in different figured worlds, and different agents are expected to take part in certain actions, the meaning of which is specific to the figured world. For example, eye-blinking may be interpreted to be flirtatious eyelash-batting in a romance

movie. In a windstorm or in an optometrist's office, the same action might be interpreted very differently.

Figured worlds in which teachers may participate (and index in their narratives of practice) include a certain discourse of mathematics education reform (such as that portrayed in NCTM, 2000), the school community, and the particular PD context in which this study is situated. Teachers may identify themselves differently in these different figured worlds, because of the different cultural resources available to them in each of those places, the different things that they perceive to be valued in those places, or the different outcomes that are seen as meaningful in those places.

While Holland, Lachicotte, Skinner, and Cain (1998) highlight the conflicts of individuals in different figured worlds, they do not consider the ways in which an individual's practices across these contexts impact their identifying narratives. Seeking a framework for completing a fine-grained analysis of the narratives teachers tell in practice, I turn to work done on student learning in mathematics education (Ben-Yehuda, Lavy, Linchevski, & Sfard, 2005; Sfard, 2006a & 2007; Sfard & Prusak, 2005).

Defining and Operationalizing The Work of Identifying

People may identify themselves directly or indirectly by constructing narratives (which I will explain in the following two sections), or by acting (Sfard, 2007). In this study I analyze teachers' direct and indirect identifying narratives. People identify directly through statements about themselves, such as "I am good at math", and indirectly by telling stories of their experience. I will first discuss the theoretical basis for indirect identifying, which people do by telling narratives. Then I will discuss the theoretical basis for direct identifying.

Indirectly identifying by telling stories. People are identifying whenever they speak because identity-building is one of the tasks of discourse (Gee, 1999/2005). People act out particular selves in the telling of narratives, using them to construct and transform themselves (Wortham, 2006). Narrative style is associated with one's cultural identity and presentation of self and making changes in narrative style is a tool for changing one's social identity (Gee, 1989). Attention to the structure of narratives and how the structures set up interpretive questions and limits for answering those questions reveals the ways people are making sense of themselves, the figured worlds in which they participate, and their interactional positioning (Gee, 1991). As a teacher tells a story of an event that occurred in her classroom and how she responded, she does so according to how she wants her listener(s) to identify her as a teacher.

Directly identifying using identifying narrative statements. *Identifying narrative statements* are the result turning stories into labels, such as *I am a capable mathematics student* or *I am a kindergarten teacher* (Ben-Yehuda, Lavy, Linchevski, & Sfard, 2005; Sfard, 2006a & 2007; Sfard & Prusak, 2005). This definition of identifying narrative statements should not be confused with narratives as defined by sociolinguists such as Labov (1972) (Juzwik, 2006), which require a number of temporally or causally related statements to be strung together. Rather, *direct identifying narrative statements* are statements made on the basis of the reification (objectification and detemporalization) of implied narratives (Sfard, 2006b).

Identifying narrative statements are statements about a person that are reified, endorsed, and significant. Reified narratives are those that a person considers to be an object that exists regardless of time. ("I am a kindergarten teacher" is a statement

objectifying experiences of teaching at a certain grade level). Endorsed narratives are those that the person would accept as true. (The person making the statement would have to agree that "kindergarten teacher" is an appropriate way to describe herself). Significant narratives are those that the person would have an emotional reaction to or would find salient and important to their self-understandings. (Being a "Kindergarten teacher" as opposed to simply "a teacher" or "an early-grades teacher" would have to be salient to the individual's self-perceptions). One's collection of identifying narrative statements can be classified into two types of identity: *designated* and *current* identity. Designated identity refers to narratives about what the person expects or desires to be in the future. (The kindergarten teacher may desire to be "a student-centered teacher") and current identity refers to narratives about the person in the present. Learning may be defined as "closing the gap" (p. 19) between designated and current identities (Sfard and Prusak, 2005) (e.g., the kindergarten teacher may come to see herself as "the student-centered teacher" she desired to become).

This theory has been used to examine students' mathematics learning. Sfard and Prusak (2005) studied the identifying narratives of students in high school mathematics to gain insights about achievement differences between two groups of students: students whose families had recently immigrated to Israel from Eastern Europe, and students whose families were native to Israel. They noticed that the newcomers to Israel generally attained higher levels of mathematics achievement than those from non-immigrant families. They highlighted a difference between the identifying narratives of immigrant and non-immigrant students. Students from non-immigrant families did not construct designated identities involving mathematics learning, but students from immigrant

families included mathematics as a central part of their designated identities. Sfard and Prusak posit that this difference in the construction of narrative identities is linked to the observed difference in mathematics achievement between the two groups of students.

In another study, Wood (2008) studied children's identifying and mathematizing (participating in mathematics instruction) in an elementary classroom where CI was being used to teach mathematics. She showed that the children's mathematizing was also a process of identifying.

This work has not been widely applied to the study of teachers. It specifically speaks to the dynamic nature of identity but has not yet been used to examine how people's ways of identifying change or remain the same from context to context. Because Holland, Lachicotte, Skinner, and Cain (1998) posit that people identify differently in different figured worlds, one might assume, when operationalizing identity as identifying narratives, as Sfard and Prusak (2005) do, that people construct a variety of identifying narratives when those narratives are set in different figured worlds. Using the concepts of identifying narratives and figured worlds together will potentially afford a more contextualized description of identifying.

Identifying and learning are interdependent, dynamic, and continually negotiated in practice. Complicating this process are conflicts between past histories with which people are comfortable, present discourses that tell conflicting stories, and different rules for the different figured worlds in which they participate. For example, a teacher may be caught between the figured worlds of reform mathematics and views of the school staff, and may be receiving messages from administrators and parents that conflict with both of these perspectives. These conflicts may affect this teacher as she improvises practice in the

flow of a mathematics lesson (e.g., as she intervenes in student groups) and evaluates this performance during and after the lesson (e.g., as she identifies as a teacher who intervenes quickly when she sees students struggling). If she objectifies or reifies her evaluation of this performance (e.g., as a "good" performance), and she is emotionally committed to that reification, it will become an identifying narrative that may affect her future learning, identifying, and practice (e.g., she may identify as a successful teacher who is quick to intervene). Understanding how teachers identify and how this is related to learning (i.e., changes in discourse or practice), helps us to understand how teachers' narrative identities, constructed in PD events or in practice, provide teachers with both resources and constraints for changing their teaching practice in order to provide equitable, rigorous instruction for students in math. A logical next move in this line of scholarship is to use the notion of identifying as narrative to study issues of knowledge, culture, and context in teacher learning in practice.

Identifying and Implementing New Mathematics Teaching Practices

As mentioned earlier, identifying may be defined as participating in a community of practice (Wenger, 1989). The teachers who participated in this study all chose to participate in the community of practice that was the CI math PD course. Therefore, in one sense, they were identifying as CI course participants. However, after the completion of the course, some teachers decided to continue participating in CI by implementing it to teach mathematics in their classroom, and some did not. Because implementing CI is essentially participation in a practice, and because participation and identifying are closely interlinked, teachers' implementation of CI and their other ways of identifying are also likely to impact each other.

Additionally, people make sense of new ideas through their *salient* identities. Lisa Jilk (2007) studied Latina women who had graduated from Railside High School (see also Boaler & Staples, 2005). She found that the students had interpreted their high school mathematics experience through the lenses of their salient identities. Likewise, it is reasonable to expect that teachers would interpret their experiences in the CI mathematics course through the lenses of their salient identities. Because of this, it is plausible to hypothesize that teachers in this study will have different stories of CI implementation based on their different ways of identifying. Indeed, research theorizing links between teachers commitment and identity has discovered that when teachers see the relationship between their values and the directions that are recommended by reformers, they are more likely to become intellectually and emotionally engaged in those directions (Day, Elliot, & Kingston, 2006). However, the connection between those commitments to reform and implementations of reform are largely unstudied.

Life Stories and Changes in Practice

Researchers have found connections between teachers' mathematics life-stories and their implementation of a reform-based curriculum (Drake, Spillane, & Hufferd-Ackles, 2001; Drake, 2006). Defining identity as a life story (McAdams, 1993), they studied elementary teachers' mathematics and literacy life stories (Drake, Spillane, & Hufferd-Ackles, 2001). They found three different plot structures for teachers' mathematics life stories: the *turning point, failing (foreclosed)* and *roller coaster* stories. These researchers discovered a relationship between teachers' life-story plot structures with their implementation of reform. Teachers who had *failing (foreclosed)* stories taught traditional lessons and focused on superficial aspects of reform; those with *turning point*

stories focused on affective aspects of reform; and those with *roller-coaster* stories focused on both affective and content-based aspects of reform.

Turning-point stories were found to be particularly influential on teaching practice. Turning-point stories are those in which a teacher recounts early experiences of failure and current positive perceptions of themselves as learners and teachers of mathematics. By more closely examining teachers with turning point stories, Drake (2006) found that the content of teachers' turning point stories impacted their implementations of reform. Teachers who had turning point stories based on mathematics content (as opposed to mathematics tools) felt that they should learn along with their students and be transparent with students, were trying to incorporate new understandings of mathematics into their teaching practice, and were looking for new pedagogies and curriculum that fit their new understandings of mathematics. They looked at reform curriculum materials and their students as a way to learn mathematics. Their observed teaching practices were coded as more strongly reform-oriented. Teachers who had tool-based turning point stories believed that manipulatives were crucial for making mathematics accessible and enjoyable. They often changed the conceptual ideas in reform-based lessons in order to include more manipulatives, actually making the lessons more traditional in nature.

Much about the relationship between teachers' stories and teaching practice is still unknown. How implementing recommendations for reform impacts experienced teachers' identifying narratives has not yet been examined, nor has the impact of the culture of schooling on this process.

The Impact of Implementation on Identifying

The research on life stories and implementation draws a one-way arrow from teachers' life stories to their implementation of a reform-based curriculum. However, in this study, I am also studying how implementing CI will impact teachers' ways of identifying.

The idea that the practice of teaching effects teachers is not a new one (Waller, 1932). This idea has been studied in preservice teacher education. For example, Britzman (2003) found that student teaching had an effect on intending teachers' identities. However, the effect of implementing a new teaching practice on an experienced teacher's identifying narratives is relatively unstudied.

One reason to hypothesize that implementing a new mathematics teaching practice will impact teachers' ways of identifying is because of the intertwined nature of participation and identifying. As stated earlier, implementing CI may be spoken of as a way of participating with the CI community of practice. As such, while implementing CI, the teachers will have new experiences with participation and therefore new ways of identifying (new narratives).

Identifying may also be conceptualized as story-telling (Holland, Lachicotte, Skinner, & Cain, 1998; Sfard & Prusak, 2005), or making sense of experience through the telling of narratives. The implementation of CI will result in new stories of mathematics teaching practice for teachers to tell. The telling of the stories is one way that teachers are likely to make sense of the experience (Ochs & Capps, 2001). Therefore, the telling of narratives in interviews for this study is also likely to lead to new narratives in the future.

Another reason to hypothesize that implementing a new mathematics teaching practice will impact teachers' identifying narratives is because learning and identifying are intertwined (Sfard & Prusak, 2005; Wenger, 1989; Wortham, 2006). That is, how one identifies impacts ones participation in learning activities, and learning impacts how one identifies. It is likely that teachers will learn something from the new experience of teaching mathematics with CI, and that this will impact their ways of identifying.

Research Questions

A goal of this dissertation is to discover more about the relationship between implementing a new mathematics pedagogy and teachers ways of identifying. Therefore, The research questions that guide this dissertation study are as follows:

1. How do teachers' ways of identifying and their stories of implementation of a new mathematics pedagogy interrelate?
2. How do teachers' ways of identifying become obstacles (or not) to teachers' attempts to change their teaching practice? How do they make sense of the obstacles and overcome them?
3. How do teachers' ways of identifying change (or remain the same) as teachers implement CI to teach mathematics?

CHAPTER 3: METHOD

In order to learn about the links between teachers' implementation of CI and their ways of identifying, I designed a two-phase study of teachers who were implementing CI. I generated data through interviews about teachers' life stories and stories of mathematics teaching practice in order to study their ways of identifying over time and in varied figured worlds.

The data collection and analysis for this dissertation was done in two phases. Phase I was a pilot phase designed to investigate the links between teachers' life stories and their decisions to implement (or not implement) CI. In Phase I, four teachers from the first cohort of the CI math PD course were chosen. I chose two teachers who had reportedly been implementing CI to teach mathematics, and two had had not. I conducted two mathematics life story interviews with each teacher to look for parallels between their mathematics life stories and their stories of implementing CI to teach mathematics. The results of Phase I are reported in Chapter 4 of this dissertation.

In order to answer the questions that I generated based on the results of Phase I, I designed Phase II of the study, which makes up the bulk of this dissertation (Chapters 5, 6, and 7). I designed Phase II to study the relationship over time between teachers' stories of CI implementation and changes in identifying. For Phase II I invited teachers from both cohorts of the CI math PD course who decided to implement CI to teach mathematics after the PD course. The data for Phase II was generated in three contexts, in order to attend to the contextualized nature of identifying and the situated nature of learning. I interviewed teachers individually about CI mathematics lessons they planned and taught in their classrooms. In addition, the teachers gathered together to share stories

of mathematics teaching with CI, and the teachers also presented their work on using CI to other teachers who had not yet taken the CI course.

Phase 1

Phase 1 Participants

Participants were chosen based on their reported and observed implementation of CI during ongoing collaboration in the months following the CI workshop. I chose teachers who expressed an interest in continuing to implement CI to teach mathematics over several months, in order to study the impact of this implementation on the teachers' ways of identifying over time. Two teachers, Shirley[4] and Jonathan, had reported making substantive changes to their classroom. Two others, Kelly and Gina, had reported using little or no CI. Kelly said she intended to do more groupwork in the future; Gina did not. I chose participants who had responded differently to the workshop so a range of workshop and classroom experiences could be studied.

Gina and Kelly taught in the same school in an urban district, with 215 K-5 students, of which 47% qualified for free or reduced lunch. The largest racial groups were Caucasian (61%), Latino/a (19%), and African American (15%) (Standard and Poors, 2006). Gina was near the end of her second year teaching kindergarten, and her 28th year of teaching. Kelly was transitioning from kindergarten to first grade and had been teaching for seventeen years.

Shirley had taught for twelve years in a suburban district. She was teaching sixth grade mathematics and science in a school of 255 fifth and sixth

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[4] All names of teachers and schools have been replaced by pseudonyms.

graders, of which 25% qualified for free or reduced lunch. The main racial groups were Caucasian (65%), African American (20%), Asian/Pacific Islander (7%) and Latino/a (6%) (Standard and Poors, 2006).

Jonathan had taught for fifteen years in a suburban district and was teaching fifth grade mathematics and social studies in a school of 400 fifth and sixth graders, of which 29% qualified for free and reduced lunch. The main racial group in the school was Caucasian (83%), with the remainder of the student body fairly evenly distributed between multi-racial, African American, Latino/Latina and Asian/Pacific Islander students (Standard and Poors, 2006).

Phase 1 Data Collection

Phase One began as a pilot to the dissertation. I developed a semi-structured, two-part life story interview protocol based on Drake, Spillane, and Hufferd-Ackles (2001). The protocol is included as Appendix A. During the first interview I elicited stories of learning and teaching mathematics and stories of participating in the CI workshop, in order to look for links between teachers' identifying narratives and stories of CI implementation. Participants were also asked to tell stories about their practice after the workshop and their implementation of CI. In the second interview, I followed up with questions that arose when transcribing and reading the first interview.

Phase 1 Data Analysis

Ways of Identifying

Plots of Mathematics Life Stories. In order to understand teachers' ways of identifying at the beginning of the study, I compared teachers' stories about learning and

teaching mathematics against the plots described by Drake, Spillane, and Hufferd-Ackles (2001) and categorized them as failure (foreclosed), turning-point, or roller coaster stories. The turning-point stories I then compared with the further subcategories in Drake's (2006) study. I compared teachers' reported implementation of reform-oriented mathematics teaching in general, and implementation of CI specifically, with those of the teachers in that literature.

Direct Identifying Statements. I noted direct identifying statements within the stories. A direct identifying statement is one that is reified, endorsable, and significant, or to which the speaker was emotionally attached. Such statements often were phrased as "I am" or "I was" followed by an adjective or a noun, or "I can" or "I can't" followed by something general or overarching, such as doing math in general. Statements in which participants stated that they were unable to carry out a particular mathematical task were not counted in this category. Other identifying narratives included those in which the participants used the words "always" or "never" in describing themselves. Consider the following two statements; both said by Jonathan near the beginning of his interview when he was asked to tell his mathematics life story:

"I took only as much mathematics as I had to take."

"And I wasn't very successful in elementary school or middle school."

Both of these are strong statements with which Jonathan is identifying; however, one fits the definition of *direct identifying statement* (Sfard & Prusak, 2005) and the other does not. When Jonathan said, "I only *took* as much mathematics as I had to take," he was describing something he *did* (or in this case, did not do). The statement has not been reified—that is, he has not objectified it into a quality of himself. The second statement,

"I *wasn't,*" is not about something Jonathan *did*, but something he *was*. Jonathan had reified many things he did (and did not do) so as to construct himself as being a certain type of person. Therefore, I did not code the first of those two statements as a direct identifying statement, but I did code the second one as such. Again, this is not to say that Jonathan is not identifying himself in the first statement. Of course, whenever we talk, we are deciding how to portray ourselves to others (Gee 1999/2005), and so the first statement contains messages about identity. Additionally, Wenger (1989) equates identity with participation, and the first statement is about participation, so in that sense, it may be recognized as being identifying. However, what I was concerned with were *direct* identifying statements as defined by Sfard and Prusak (2005) specifically, in order to further their line of research about a particular way of identifying that includes statements that are reified, endorsable, and significant.

Figured Worlds

In order to attend to the contextualized nature of identifying, I analyzed the identifying narratives to see if they invoked particular figured worlds. Figured worlds included the CI community, Teacher Education, mathematics reform (for which there seemed to be at least two different figured worlds, including different iterations of reform or teachers interpretations of those), schooling in the past, the community of school colleagues, the political/administrative realm, and social situations outside of school.

An important note is that I did not intend to draw firm lines between categories of identifying narratives or figured worlds. I analyzed them as such because I noticed that teachers often told contradictory stories of themselves, and I hypothesized that they were identifying differently when telling stories set in different figured worlds. However,

sorting and categorizing the identifying narratives was not at all a definitive or clean process. I placed several statements into multiple categories of figured worlds. At times, it was difficult or impossible to identify with certainty whether a particular statement referred to one particular figured world or more. The exercise did help me to see patterns in identifying narratives, but should not be considered the only or even the best way to classify identifying narratives.

Phase II

In Phase II I deliberately collected teachers' narratives of teaching with CI that they told in different contexts and analyzed these to illuminate the relationships between identifying and changes in teaching practice. I studied a group of teachers who had chosen to make CI a part of their mathematics teaching practice. I examined issues of context as I interviewed these teachers in a variety of contexts and around artifacts of practice from February-October, 2008. The teachers participated interviews in three contexts: in individual interviews, group interviews, and presentations of their work to those who had not yet taken the CI course. The purpose of the different interview types and contexts was to gain more insight about the impact of context on identifying.

Phase II Participants

Four teachers participated in Phase II from the beginning to the end[5]. In the sections that follow, I report on the cohort of the CI math PD course in which each teacher participated, how they had been using CI to teach mathematics, and the demographic characteristics of the teachers and the contexts in which they work.

Jonathan

Jonathan was the only teacher who participated in both phases of the study. Jonathan had participated in the first cohort of the CI math PD course (summer, 2006), and had been using CI to teach mathematics for a year and a semester. During his first year of CI math implementation, he reportedly taught 12 CI math lessons, all of which he designed himself by adapting other mathematics tasks.

At the beginning of Phase II, Jonathan had taught for sixteen years in a suburban district that I call Cornerstone. He is a white male in his late 40s who had entered teaching as a second career (previously he was a manager at a retail store). During Phase I and the beginning of Phase II (February-June, 2008) he was teaching fifth grade mathematics and social studies. However, at the end of Phase

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[5] A fifth teacher (Kelly, from Phase I) began Phase II with the other four teachers. Between Phases I and II she reported using several CI mathematics tasks in her classroom, and expressed interest in participating the study, especially in order to participate in the group discussions with other CI teachers. However, after participating in one set of individual interviews and one discussion group session, Kelly decided that study participation did not fit into her schedule, and decided to stop participating. Although she consented to allow me to analyze the data, I decided to report in this dissertation only on the four teachers who participated in Phase II from beginning to end.

II (August-October, 2008) he was teaching only fifth grade mathematics.

At the beginning of Phase I Jonathan's school had 400 fifth and sixth graders, 29% of whom qualified for free and reduced lunch. The main racial group in the school was Caucasian (83%), with the remainder of the student body fairly evenly distributed between multi-racial, African American, Latino/Latina and Asian/Pacific Islander students (Standard and Poors, 2006). By the end of Phase II, the demographics had changed; 39% of students qualified for free and reduced lunch. The breakdown of racial groups was Caucasian (78%), African American (11%), Latino/a (7%), Asian/Pacific Islander (3%), Multi-Racial and Native American (1% combined) (Standard and Poors, 2009).

Glynnis

Glynnis participated in the second cohort (Summer, 2007) of the CI math PD course. She had reportedly used one of the CI structures—roles—for a couple of lessons at the time Phase II began, and her classroom norms were similar to those taught in the CI course. Glynnis said that she wanted to participate in this study because she wanted to do more with CI.

At the beginning of Phase II, she had been teaching fourth grade for eight years in an urban district. She is an African American female in her 50s, who entered teaching as a second career (before that she worked in the district's administration office).

Glynnis was teaching in a school I call Riverside, in which 275 kindergarten through fifth grade students were enrolled, 65% of whom qualified for free and reduced lunch. Racially, the students were African American (66%),

Caucasian (15%), Latino/a (12%), and Asian/Pacific Islander (7%). Glynnis reported that the demographics of the school had changed at Riverside during her tenure there, having gone from a student body that was primarily Caucasian to a student body that was primarily African American[6]. The school is located near the edge of the city. When she began teaching at Riverside, she was one of two African American teachers in the school. At the time of this study, she was one of three.

Joanna

Joanna, like Glynnis, had participated in the second cohort (Summer, 2007) of the CI math PD course. She had been using CI mathematics tasks in her teaching for about one semester when Phase II began. Joanna reported using CI tasks occasionally, usually using tasks from the *Group Solutions, Too* (Goodman & Kopp, 2007) book that was distributed at the CI course.

At the beginning of Phase II, she was in her tenth year as a teacher. She was in her eighth year of teaching third grade in her current school, which is a rural school I call Edgefield Elementary. Prior to that school, Joanna had taught for one year at another rural school, and had had two semester-long positions elsewhere. She is a white female who entered teaching after her children entered school.

Edgefield Elementary enrolled about 360 students in grades kindergarten through fifth, 12% of whom qualified for free or reduced lunch. The main racial group in the

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[6] I am reporting here only on the demographics of the school during the duration of the study. Therefore, I have not included statistical data demographics of the school during Glynnis' entire teaching career, other than to report what she told me about changes she had noticed.

school was Caucasian (90%). Five percent of the students identified as African American, 2.5% as Hispanic, and the remainder Asian/Pacific Islander or Native American (Standard and Poors, 2009). The Edgefield school building was built as an open school. Therefore, there are no walls between classrooms. Instead, teachers have arranged their furniture (such as cabinets, bulletin boards, and the like) in order to designate spaces for each teacher's "classroom".

Patricia

Patricia was another teacher who had participated in the first cohort (Summer, 2006) of the CI math PD course. She had been using CI mathematics tasks in her teaching for one year and one semester. Patricia reported teaching one CI mathematics task each week, which she took directly from *Group Solutions* (Goodman, 2000), a resource distributed to teachers in the PD course.

At the beginning of Phase II, she had been teaching for 32 years in a suburban district. She is a white female who was in her 50s and had begun her teaching career in a rural district as a special education teacher specializing in emotional impairments. She had also worked as a teacher consultant before moving to her present district, where she first taught in a special education classroom. At the beginning of Phase II she had been teaching first grade (not special education) for seven years.

Patricia was teaching in a school I call Circle Pines, in which 330 kindergarten through fifth grade students were enrolled, 12.4% of whom qualified for free or reduced lunch. The main racial group in the school was Caucasian (64%), with the second largest racial group being Asian/Pacific Islander (24%).

African American students comprised 7% of the student body, and Latino/a students 5%. (Standard and Poors, 2009). Circle Pines is located in a district that borders a university town.

Phase II Data Collection

Individual Interviews

In order to collect narratives that were situated as closely as possible to the teachers' practice, I conducted approximately three sets of interviews with each teacher from February to October, 2008. Each set of interviews consisted of a pre-interview before teaching a CI mathematics lesson and a post-interview after it. I focused the conversation as closely as possible to particular episodes of classroom practice.

I asked teachers to bring one or more artifacts from teaching the lesson (such as student work, a lesson plan, a video- or audio- recording, journal notes, etc.) to facilitate the telling of narratives.

I had intended to do four interviews, thinking that I wanted to limit the number of interviews because teachers find that it takes significant time and effort to plan for each CI lesson, especially when first beginning to use CI. One teacher who has said that he is very committed to including CI in his practice reported that he was able to teach about twelve CI mathematics lessons in his first year following the CI workshop. Therefore, I realized that teaching and discussing four lessons using CI over the course of one semester would be a significant undertaking for teachers. My assumption was correct, and in fact I was only able to conduct three sets of interviews with each teacher. (See Appendix B for the protocol for an interview around a CI lesson).

Groupwork Interviews

Teachers also met together three times to share stories of using CI in math, solve problems of practice together, and participate in focus-group interviews. This provided another context and audience for teachers' storytelling, and allowed me to gather a broader range of stories of teaching practice. I suggested that the stories could be about the same lessons they focused on in their individual interviews, or different lessons, depending on the teachers' wishes.

The discussion was loosely structured using a "Round Robin Protocol" (Teachers Development Group, 2005), which teachers used during the CI workshop. The purpose of the protocol was to provide the teachers' with some structure for continuing the conversation but allowing me to give fewer (or no) oral promptings during the group discussions. (See Appendix C). At the first meeting, I gave the teachers a copy of the protocol, explained that I wanted to hear stories from each teacher and that the purpose of the protocol was not to rigidly enforce a structure but to communicate to them what I was hoping to hear. The teachers agreed to the structure of the protocol. At the beginning of each of the two subsequent meetings, I reminded teachers of the protocol, asked them to take a few minutes of quiet time to think about their stories, and then simply asked who had something to share. After starting the discussion I rarely spoke.

Presentations About CI

In order to provide a third context and audience for teachers' storytelling, I invited teachers participating in this study to present their work on CI to teachers who had not yet taken the CI course. Jonathan co-presented at a regional Fall Educator's Conference with

me in October, 2008. (I presented in person, while Jonathan was present via Skype). Glynnis and Joanna were interested in presenting at that same conference, but could not get time away from their classrooms to do so. Therefore, they videotaped presentations to be played at that conference. Also in October of 2008, all four teachers presented their work on using CI to teach mathematics to new mathematics education instructors, who were interested in learning more about CI. These presentations were audio and video recorded. The purpose of asking teachers to present in these venues was to generate stories told in a different context to a different audience because identifying is contextual.

Summary of Data Collection

In order to broaden the contexts in which the stories were told and thus attend to the contextual and dynamic nature of identifying, different participants participated in individual interviews at different times and in different places. This was also a result of my desire to avoid interrupting the teachers' schedules when possible. I arranged to interview the teachers around their CI lessons whenever they had planned to teach them. Additionally, not every teacher was able to be present at every teacher discussion group meeting, due to conflicting schedules. The data collection events, dates, and teachers' present are reported in Table 1.

Table 1. Data Collection

	Patricia	Joanna	Glynnis	Jonathan
Life story Interview	03-11-08 &	9-14-07	9-12-07	6-11-07 & 7-9-07
Individual Interview 1 (pre- and post-)	03-11-08, 03-18-08, & 03-21-08	4-18-09 & 4-25-08	3-5-08 & 3-25-08	4-01-08 & 5-05-08
Individual Interview 2 (pre- and post-)	4-22-08 & 4-29-08	5-2-08 & 5-15-08	4-23-08 & 4-30-08	5-05-08 & 5-23-08
Individual Interview 3 (pre- and post-)	5-22-08	9-26-08 & 10-20-08	10-06-08 & 10-26-08	9-25-08 & 10-07-08
Group Discussion 1 (4-15-08)	Participated	Participated	Participated	Participated
Group Discussion 2 (5-15-08)	Participated	Participated	Participated	Absent
Group Discussion 3 (8-18-08)	Participated	Participated	Participated	Absent
Round-Table Presentation to Instructors (10-20-08)	Participated	Participated	Participated	Participated
Fall Educator's Conference (10-10-08)		Videotaped presentation	Videotaped presentation	Presented live via video conference

Phase II Data Analysis

Direct Identifying Statements

As in Phase I, I noted the direct identifying statements uttered in the interviews, discussions, and presentations. See Phase I for a description of the method.

Narratives

I set apart the stories told by teachers from the other types of discourse (I use "stories" and "narratives" interchangeably.) Some researchers have posited that defining

narrative according to a set of structures is too constraining to be helpful; however, leaving narrative undefined, and therefore considering *everything* to be narrative, is equally unhelpful (Georgakopoulou, 2007). The Oxford English Dictionary (2003) defines narrative as "An account of a series of events, facts, etc., given in order and with the establishing of connections between them; a narration, a story, an account." Recounting events in order is indeed a part of some definitions of narrative (Labov, 1972). However, narrative analysts have disputed whether the order of events needs to be chronological. In many cases, narrators use techniques such as foreshadowing and backshadowing to build coherence or suspense in a story, or to explain events within a story. Or events may be linked causally (Ochs & Capps, 2001). Some theorists have suggested that narratives need to have a beginning, middle, and an end in order to count as narratives, but Ochs and Capps (2001) posit that narratives are often left with no conclusive ending, especially when the narrators are using the narration to make sense of an event or inviting others to help them make sense of an event. Others have suggested that the difference between narrations and recounts lies in whether or not the retelling of the events contains an *evaluation,* a term used by Labov, (1972) or *moral stance taking*, a term used by Ochs and Capps, (2001) (Juzwik, 2006). For this study, I define a narrative as an account of an event or events including an element of time (although it may not be told in chronological order) and consciousness (a social and emotional purpose for telling the narrative).

When narratives are constructed within a group of people who may be competing for turns in a conversation they emerge differently, in ways that are more fragmented than those individuals tell in interviews. In a group, participants may perceive that long

stories should be avoided. When telling longer stories, interlocuters in groups seem to perceive a need to justify their reasons for taking time from the group to tell the stories. Additionally, the group builds a core body of shared knowledge of these stories, and may reference prior story-tellings without including all of the details or structures often used to construct narratives (Georgakopoulou, 2007). This requires an analyst to take a slightly more flexible approach, attending to retellings that emerge in pieces during ongoing interactions. Not all stories are told as self-contained units. Therefore, when analyzing the study-group meetings or the data generated during the CI workshop, I also looked for retellings of events across the turn-taking interactions and across multiple meetings.

I have categorized the types of stories I collected according to three categories. *Life stories* are stories are just that—stories of teachers lives. These were generated when I asked teachers to talk about their mathematics autobiographies (as in the Phase I interviews and in the exit interviews for the 2007 cohort of the CI math PD course). Teachers began by talking about their participation in mathematics as children and talked about experiences with learning and teaching mathematics up until the time of the interview. These stories covered the longest time period. The second category of stories I collected are what I call *recounts of episodes*. These stories are stories of specific episodes that occurred during their teaching and learning. Of course, the teachers' life stories were comprised of several recounts of episodes, but instead of closely analyzing these episodes, I looked overall at the plot of the entire life story. Most of the recounts of episodes I analyze in detail in this dissertation are stories teachers told within their interviews about specific CI mathematics lessons. The third category of narratives are what Sfard (2007, 2006a) calls *direct identifying narratives* but which I am calling *direct*

identifying statements so as not to confuse them with the other types of narratives I am studying. As mentioned in Chapter 2, these are not narratives according to the definitions of narrative used by linguists (Juzwik, 2006) but are statements made on the basis of reified narratives of experience (Sfard, 2006b). The types of stories collected are listed in Table 2, along with the dates collected (*direct identifying statements* are not included in this table because those were found across all the teacher discourse).

Table 2. Types of Data and Dates Collected

Phase	Stories	Data	Date(s)
1	Life Stories	Two-part life-story interviews with Phase I participants (Gina, Kelly, Shirley, and Jonathan)	May-July, 2007
2		One-part life-story exit interviews with participants who were in the 2007 cohort of the CI PD course (Glynnis and Joanna)	September, 2007
2		Short life-story interviews as a part of other interviews for Patricia (because she did not participate in Phase I but was in the 2006 cohort and therefore did not have an exit interview after the 2007 workshop).	March 11, March 21, and April 15, 2008
2	Recounts of Episodes	Individual pre- and post- CI math lesson interviews	March 5, 2008- October 26, 2008
2		Teacher discussion group sessions	April 15, 2008 May 15, 2008 August 18, 2008
2		Presentations to teachers/instructors who had not yet taken the CI course	October 10, 2008 October 20, 2008

Narrative Structures

I coded the narratives for narrative structures (Gee, 1989; Labov, 1972). Attention to structure can provide an initial way of cutting into data that can bring ambiguities into view (Riessman, 1993) as well as to set up interpretive questions and constrain possible interpretations of them (Gee, 1989). One structural element I looked for is what Gee refers to as *main line* vs. *non-main* line parts of the narrative. Looking for main line

(plot) and non-main line (asides, descriptions, etc.) parts of the narrative helped me to interpret the speaker's purpose for telling the story (Gee, 1989). What Labov (1972) calls *evaluation* is what Gee's (1989) analysis of main line/off-line of the plot uncovers. It is the "so what" piece of the story, the part that allows the listener to understand why the story was told.

I also looked for the unexpected event (Ochs & Caps, 2001) or problem of the story and the resolution to the problem in the story. This helped me to interpret how the teacher understood her role and the students' roles in the classroom. I noted issues such as who or what caused the problem, and to whom does the teacher attribute the resolution.

Ethnopoetics and Metaphors

In Chapter 7 I present a micro-discursive analysis of the poetic and linguistic structures of two stories. I present my method in more detail as I report on the results in that chapter, but I will give an overview of the methods here. I looked for syntax and cohesion in the stories (Gee, 1991) such as repetition of words and grammatical structures. I would compare several similar-sounding sentences side-by-side to see if they could all fit into one similar template, for example. I also looked at alliteration within lines of text, repeated words and phrases (Juzwik, 2004).

I looked for shifts in the psychological subjects (Gee, 1991) in two ways; I looked at the pronouns in the stories to note the pronominal shifts. And I looked at how the teacher shifted between participant and spectator roles as she told the story (Crespo & Juzwik, 2006). I also analyzed the stories for clues as to the metaphors of arithmetic the teachers were indexing (pointing to linguistically) and the way that they shifted between

the metaphors. In these two stories, the teachers were both narrating a story about a lesson in which students were placing numbers (fractions and decimals) on a number line.

Grounding metaphors. Lakoff and Nuñez (2000) theorized four *grounding metaphors* that ground arithmetic to physical objects—the *metaphor of object collection*, the *metaphor of object construction*, the *measuring stick metaphor*, and the *metaphor of motion along a line*. Fractions are often understood using the *metaphor of object construction*, because they are constructed by dividing a whole into parts. In that case, a key metaphor is *numbers as objects*. In the *measuring stick metaphor*, arithmetic is conceptualized as the use of a measuring stick. Numbers are physical segments, with the basic physical segment being one. Longer segments are greater and shorter ones are less. Arithmetic is putting segments together and taking them apart.

Linking metaphors. Linking metaphors take us beyond the physicality of grounding metaphors to more sophisticated ideas. The metaphor of *numbers as points on a line* is an example. It builds on the measuring stick metaphor and the metaphor of arithmetic as motion along a path but maps these ideas onto the concept of a line (instead of a physical object). This requires understanding several other metaphors: a number P^1 as point P^1 on a line, zero as a point 0 on the line, one as a point 1 to the right of 0, etc. Sophisticated mathematical understandings and are built by layering metaphor upon metaphor, a process called *conceptual blending*. In contrast, teaching mathematics involves unpacking the layers of metaphor, in effect, unblending, and deftly moving between metaphors to facilitate students' conceptual blending.

CHAPTER 4: TO IMPLEMENT OR NOT TO IMPLEMENT: LIFE STORIES

> What do you suppose would be his answer if someone told him that what he had seen before was all a cheat and an illusion, but that now, being nearer to reality and turned toward more real things, he saw more truly?...And if he were compelled to look at the light itself, would not that pain his eyes..And if, said I, someone should drag him thence by force up the ascent which is rough and steep, and not let him go before he had drawn him out into the light of the sun, do you not think that he would find it painful to be so haled along, and would chafe at it?
>
> -Plato, "The Allegory of the Cave"
> (Reed & Johnson, 2000, p. 12)

> Rita: But don't you realize I want to change.
>
> -*Educating Rita* (Cartlidge & Gilbert, 1983)

Overview

In the film, *Educating Rita*, Rita desired to change herself by studying literature. In Plato's allegory, however, he describes the learner as having to be dragged into the light. As a teacher and a teacher educator, I have wondered why some teachers seem eager to take on certain new pedagogies and practices, others are interested in learning different practices, and some seem to avoid change in their mathematics teaching practices altogether.

Mathematics teacher educators and professional developers have long been concerned that teacher PD does not always result in teachers adoption of new pedagogies as a part of their mathematics teaching practices. As I note in chapter two, the effectiveness of PD remains a subject of controversy (Wilson & Berne, 1999).

However, I argue that teacher learning and changes in teaching practice involve more than simply taking in some new information and then doing something new in the classroom. Learning is impacted by how one identifies. That means that what one chooses to learn is impacted by one's designated identity—the kind of person one wants

to become (Sfard & Prusak, 2005). Just as Rita was compelled to study literature, even when the implications for her identity were clearly articulated, some teachers choose to learn about and implement new teaching practices. Why might some teachers be inclined to innovate and renew their practices by adopting pedagogies taught in PD courses, and others not? How is it that a teacher comes to see certain invitations to change as being worth her time and effort?

As I explained earlier, identifying may be defined as participating in a community of practice (Wenger, 1998). Choosing to implement a given recommendation from a PD course is then one way of identifying (participating). Adopting this lens as a way to describe teachers' decisions to implement new practices (or not) means acknowledging that there is more to changing teaching practice than simply picking up a new teaching tool and using it. Choosing to implement new mathematics teaching practices necessarily has implications for how teachers identify themselves.

Another way people identify is through storytelling about their participation. You may recall from chapter two that two types of narratives that make up identity are life stories (Drake, Spillane, & Hufferd-Ackles, 2001) and *direct identifying statements* (Sfard & Prusak, 2005).

I examined four teachers' narratives of themselves and their stories of implementation of CI to teach mathematics to look for parallels and contradictions between them. I compared how teachers' identified in the present with how they identified themselves in the past. I compared how they identified as teachers (presently) with how they identified as students (in the past), and how they identified as teachers after the CI workshop (presently) with how they identified themselves as teachers before

the workshop. I also compared and contrasted their ways of identifying in different figured worlds.

In this chapter, I report on the life story data, which I collected as Phase I of my dissertation. During that Phase of the dissertation, I chose four teachers from the first cohort of the CI course. Two of the teachers had reported implementing CI, and two had not. I interviewed them about their mathematics life stories because I hypothesized that their decisions to participate (or not) in implementing CI might parallel the ways they identified in their life stories. Sometimes this was the case; however, it was not as straightforward as I originally hypothesized. In this chapter, I demonstrate how the teachers' narratives function to propose reasons for deciding to implement new practices (or not).

In the results section of this chapter, I present the cases of each of the four teachers. For each case, I first summarize the teacher's ways of identifying. I do this in two ways: a) I summarize the teacher's mathematics life story and describe its plot as either Failing (Foreclosed), Turning-Point, or Roller Coaster (drawing from Drake, 2006 and Drake, Spillane, and Hufferd-Ackles, 2001); b) I list the teachers direct identifying statements and the figured worlds that provide the context for each of them. Secondly for each case, I describe the parallels (and sometimes contradictions) that I discovered between the teacher's ways of identifying in narrative and stories of implementation (or not) of CI.

In the discussion section, I theorize that at least sometimes for some teachers, the decision to implement recommendations from the PD course was made, at least in part, because there were parallels between the teachers' perceptions of the CI practices and

principles being implemented and the teachers' ways of identifying in their narratives. However, this did not always happen, and so I set forth some hypotheses as to why. I also describe how the results of this Phase of the dissertation led to the problem of study for the following chapters.

In Chapter 1 I described how the story I uncovered in my dissertation is parallel to the stories told in Chapter 1. In the present dissertation chapter, I am reporting on the Act I and Plot Point 1 of this story, in which I describe how teachers' ways of identifying and their decisions to implement CI to teach mathematics are related. A graphical representation of where this chapter fits into the plot structure of this story is shown in Figure 5. Figure 5 has the same graphic representation of the story plot as Figure 3, except that the scope of this chapter is highlighted with bold outlines

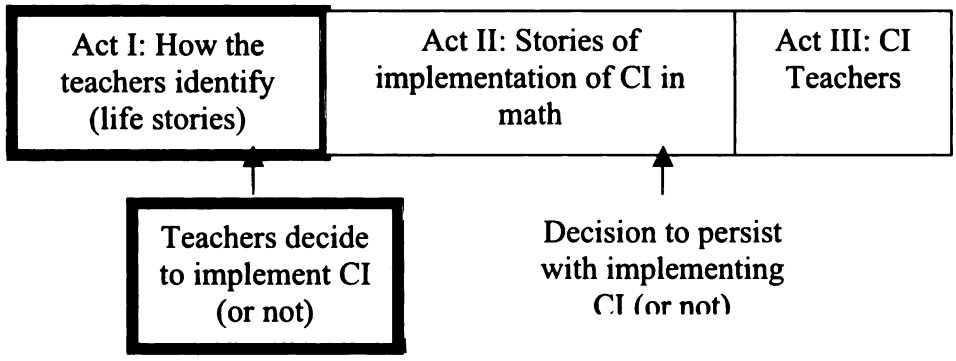

Figure 5. Chapter 4--Act I and Plot Point 1

Cases of the Four Teachers

Gina

Ways of Identifying

Mathematics life story: failure (foreclosed). Gina told a failure (foreclosed) mathematics life story (Drake, Spillane, and Hufferd-Ackles, 2001). In failure

(foreclosed) narratives the storyteller describes negative mathematics learning experiences with one or more failures or near-failures. Additionally, these storytellers accepted their early failures as predictors of their future experiences. Gina began:

> The one thing in grade school though that sticks in my mind is having to memorize my multiplication tables. That year I had rheumatic fever. So I missed a whole semester of school. And I've always had a hard time and been nervous. So I think it was more of a nervous thing, but I can remember standing in front of the teacher's desk after school was out saying the multiplication tables to her until I had said them all up to twelve before she'd let me go to the next grade. And I remember I could say them perfectly at home and then I would get up and stand in front of her desk and if you made one mistake you had to come back the next day.

In this excerpt, Gina described a failure in school mathematics—a hallmark of a failure (foreclosed) story.

Another characteristic of failure (foreclosed) stories is the interpretation of early failures as predicting future failure, or "foreclosing" their mathematics identities. Gina continued her story:

> I can remember after church on Sunday going over to my cousin's house because she was really good at math, and she tutored me all the way through 10th grade when we were taking geometry. That's how I made it through. She helped me all the way.
>
> I just never felt like I could get it. I went to Catholic school and if you didn't get it that was too bad. They went on and you had to find your own way. So you know Mary, my cousin helped me, and that worked out really well.
>
> But I didn't like it at all. When I could quit taking it, I didn't take any more math either.

Here, Gina described being rescued from near-failure by a more competent cousin, continuing the plot of her failure (foreclosed) mathematics story. She also described herself as never understanding mathematics, indicating her acceptance of these early

experiences as predictors of lifelong mathematical weakness, another characteristic of failure (foreclosed) stories.

As a teacher, Gina continued to describe herself as mathematically weak:

> When I was teaching sixth grade I was about two chapters ahead of the kids. And one of the things I was reading about, the negative numbers, and it all made more sense then. So I always told myself I wasn't developmentally ready for that when they gave it to me.

Gina explains her early weakness by saying that mathematical ideas were forced on her before she was ready, which foreclosed her mathematical future.

When Gina told of her participation in teacher PD, she continued to describe herself as mathematically incompetent. She said of mathematics PD events:

> I always have this fear that I'm going to look stupid, you know? So [I] would sit with the [district] teachers and it would be ok. I've learned how to kind of hang back and say, "Oh yeah, ok."

As Gina said, "Oh yeah, ok" she gestured that she would respond as though she understood what was said. Gina threaded experiences of failure throughout her mathematics life story from beginning to end. Therefore, I categorized Gina's mathematics life story as having a *failure (foreclosed)* plot.

Direct identifying statements and figured worlds. Table one illustrates the direct identifying statements Gina made during the interview, and also the figured world to which she was referring when she uttered each (in italics).

Table 3. Gina's Direct Identifying Statements and Figured Worlds

Identifying Statement	Figured World
As a person or teacher (in general)	
I'm a much better language arts teacher than I am math.	Her classroom
I am not waiting for it to end like some people	Her school
I never pay attention to how long [until retirement].	Her school
We're kind of isolated down here.	Her school
I always wanted to be a teacher.	Schooling (adult)
I knew that I could do a little bit better than some of the nuns that I had.	Schooling (adult)
I'm a realist.	Multiple figured worlds.
As a mathematics teacher	
I could keep that going [first grade math centers].	Her classroom
I could actually show them and use that equals sign.	Her classroom
Still a little scared and standoffish even though it's just kindergarten math.	Her classroom
I was pretty comfortable teaching them how to add and subtract.	Her classroom
I would always let them use their fingers.	Her classroom
As a math person	
I was never quick.	Math class (student)
I never felt like I could get it.	Math class (student)
I've always had a hard time and been nervous.	Math class (student)
I can always remember wanting one of those crowns but never quite being able to get it.	Math class (student)
I never cared for it and I always felt that I couldn't do it. And I just don't want [my students] to feel that way.	Math class (student); Her classroom
I was just not proficient in that kind of math [upper elementary grades].	Her classroom
I'm never going to get there.	Her classroom
I always have this fear that I'm going to look stupid.	Math PD
I can't do it.	Math PD
I was ok.	Math PD
Any time that there's math involved, I feel nervous.	Math PD
I can do more math than what I thought.	CI PD
I can understand more math than what I though. And maybe I shouldn't have that big fear, but I do.	CI PD
I can see that. I get it.	CI PD
I can't do some of this math. And I'm gonna look, you know.	CI PD
I had to be one of the explainers.	CI PD
I can handle this because it's going to be the elementary math. Well then, when it was more, whoa. I don't know about this.	CI PD

One notable pattern in Table 1 is that when Gina describes herself as a teacher, she describes herself as competent. However, when she describes herself as a math person, she describes herself as incompetent, except when she talked about the CI course. While she still mentions feeling some inadequacy in that figured world, she also stated that she learned to see herself as less mathematically incompetent there. However, this

does not indicate a turning point. A turning-point experience is one that results in the teacher realizing that it is possible to succeed at and enjoy mathematics, which Gina did not indicate.

Mathematics Life Stories, Figured Worlds, and Choosing Not to Implement CI

Gina reported no changes in practice after the workshop. This fits with the patterns reported by Drake, Spillane, and Hufferd-Ackles (2001), who found that teachers with failing (foreclosed) mathematics life stories did not implement reform recommendations.

When asked why she did not implement CI, she stated that she did not believe it was developmentally appropriate for young children to work together. As you recall, in her mathematics life story she ascribed her failure to being introduced to concepts before she was developmentally ready. In that way her mathematics life story and her discussion of CI are parallel. These early stories of failure seem to be very powerful influences on Gina's instructional decision-making.

In her stories about learning mathematics, Gina ascribed her survival (if not success) to supportive others (her cousin, colleagues). She described herself as less incompetent in the CI workshop than in other figured worlds. Even though she ascribed her survival to working with others, she chose not to have students work together. In that sense, her choice not to implement CI contrasts her own mathematics life story. One might expect Gina to want to give her students collaborative experiences because they helped her, but she did not. Again, it appears that Gina's early experiences with failure and her early foreclosure of her mathematics identity were powerful influences on her

instructional decision-making—enough so to make her contradict even her own stories of survival.

Kelly

Ways of Identifying

Mathematics life story: Two turning points. Kelly, also began her story with experiences of not understanding mathematics, but later told of a turning point. Again, teachers with turning point stories describe early failure in mathematics but recent episodes of positive experiences that changed how they identify in regard to mathematics. Kelly began:

> All of that was just rote. It was paper pencil. You do the problems. You don't know why you're doing them...I took a couple of college prep type of things. Math wasn't one of them that I was taking because math wasn't my thing. High school was when it was more frustrating. Doing the algebra and not really realizing why we were doing all those formulas and how to apply those formulas. In college, because I didn't take educational math, I had to go through certain math classes and just take them as an independent study. I remember a couple of them not passing it right away, like with fractions and stuff. Because it didn't make sense.

Kelly's descriptions of specific failure in mathematics are characteristic of both failure (foreclosed) and turning point stories. Kelly continued:

> When I really started understanding math was when I was a substitute teacher for Nancy Glenn. She's in Westfield and she was in the math department for them for elementary. I went to Westfield so I knew her quite well. They were doing, what was the math program called? It was totally hands on. It was first the concrete, and then going from there the pictorial, and then from pictorial to the abstract. And moving from each one. And all of that stuff with the multiplication. I'm like, aah, this all makes sense.

Turning point stories include a recent positive experience that changes the teachers' views. Tool-based turning point stories are those in which the turning-

point came about because of materials. Because of Kelly's emphasis on tools in this story (manipulatives, pictures), it can be classified as a tool-based turning point. Kelly's new understandings were based on the tools that she was asking children to use. As a result of this experience, she believed that she could do and teach mathematics.

Later, Kelly had another important turning point in her mathematics life story. She described the CI course as important to her understanding of mathematics as a discipline:

> I was very uncomfortable initially with the Complex Instruction, because I did not feel like I fit there at all...For me to have to do these extensive math problems it was going to be hard for me to feel positive because everyone around me understood math concepts, I felt, a lot better than I did. And how to solve these mathematical problems that were middle school, high school, you know, higher than what I had been doing in many, many years. So it was at first very frustrating. And then after a couple of days it started being, it was just very positive... First, total frustration. I was probably going to waste my time. To, "You know what, I can do this. I have the ability to help with finding the answer and I can do something to benefit my group"...The way we were taught that there are many different ways to solve a problem and there's no right way, there are just many ways. And so having more than one person working on this makes a lot of sense with math period. You know, it's not a one-person.

Kelly's turning point in the CI workshop was a *content-based turning point*, because she started to see mathematics as a discipline as a social activity where diversity of ideas is important.

Direct identifying statements and figured worlds. Kelly identified in strikingly different ways in different figured worlds. Table 2 shows her direct identifying statements and the figured worlds to which she was referring when she uttered them.

Table 4. Kelly's Direct Identifying Statements and Figured Worlds

Identifying Statement	Figured World
As a person or teacher (in general)	
I was a substitute teacher.	The classroom
I was second grade.	The classroom
I'm very good at change.	Multiple figured worlds
I'll tell everybody. I don't, I don't hide anything.	Multiple figured worlds
As a mathematics teacher	
Knowledgeable.	Her classroom
I can go to sources.	Her classroom
Being able to go with the Investigations and not just fall back to the ways that I used to teach.	Her classroom
Confident and more knowledgeable.	Her classroom
I think I'm doing well.	Her classroom
More comfortable because I know what I'm supposed to be teaching.	Her classroom
I know maybe many different avenues to get there.	Her classroom
Pretty confident.	Her classroom; mentoring relationship
I will never tell you that I know everything.	Her classroom; mentoring relationship
I'm knowledgeable.	Her classroom; mentoring relationship
I can teach the kids and teach them to understand why they're doing it.	Reform-based math; her classroom
I can do this.	Reform-based math
I understand the new way of doing math.	Reform-based math
I can help her.	Reform-based math; her family
When I'm around adults, I don't see myself as a math teacher.	Her social circle; Her school; PD events
I'm just this little kindergarten teacher who does not have a background in math.	Her social circle; her school; PD
I was gung ho for it.	Complex instruction
As a math person	
Math was not my forte.	School (as student)
Math wasn't my thing.	School (as student)
I don't see myself as confident in math [around adults].	Her social circle; Her school; PD events
I did not feel like I fit there.	CI PD
I could do that stuff.	CI PD
I can do this.	CI PD
I have the ability to help with finding the answer.	CI PD
I can do something to benefit my group.	CI PD
I could answer if I needed to.	CI PD
I can do these kind of things.	CI PD
I could tell [explain how my group solved the problem].	CI PD
I don't get better at math.	All figured worlds.

Most notable is the pattern whereby Kelly identifies as mathematically incompetent in her social circle and with her colleagues, but competent when in her own

classroom and mentoring student teachers. It is also notable that this changes when she is talking about herself in the CI math PD experience, which would be a context in which she was "around adults," and yet directly identified as capable.

Mathematics Life Stories, Figured Worlds, and Choosing to Increase Students' Opportunities to Talk to Each Other

Kelly had reported not using CI in her classroom after the PD course. However, she did report changes in her teaching practice that she attributed to her experience in the course. She stated:

> I always did [group work] with reading and instructional centers. But I did not do it much with the math. Whereas, now it's pretty much every time they go work on something, it's with a pair.

Kelly ascribed this change in her practice as being based on a new conception of what it means to do mathematics, which she gained from the PD course:

> Because I realized that two brains are better than one. Again it was just the way that I was brought up with math, you did it all by yourself. It was never a group effort. And the grouping makes so much more sense because of the way math is set up.

According to Drake's (2006) findings, recent, content-based turning point stories, such as Kelly reported experiencing in the CI course, are often accompanied by content-based implementations of reform, such as Kelly described.

But Kelly had also described an earlier, tool-based turning point at the beginning of her teaching career. Interestingly, Kelly reported that one of the constraints to her mathematics teaching practice was lack of time to prepare tools and lack of resources. She said:

> I enjoy teaching mathematics but it's hard because of the manipulatives and the time constraints. Just doing the manipulative part takes a long time.

Initially this seemed puzzling, since implementing CI need not require a lot of tools. I wondered why Kelly had not chosen to implement CI in order to ease this difficulty. However, it is possible that another challenge to implementation for her is the conflict of different messages about mathematics reform from the two different figured worlds: figured worlds that provided the setting for her first turning-point story (an earlier wave of mathematics reform) and her latest turning point story (which was set in the figured world of the CI workshop).

Shirley

Ways of Identifying

> *Mathematics life story: Turning Point.* Shirley's story began:
> I don't think I felt I was very good at math. It was probably encouraged quite a bit by the teaching staff because, in retrospect I think they really felt that girls, it was just pointless. Why, why were you doing this. It wasn't as rigorous as it is now either. We didn't have AP, AP was just starting, so there was no push to keep churning through. When I was in college I continued thinking I couldn't do math.

Both failure (foreclosed) and turning point stories begin with negative experiences and one or more stories of failure. Shirley described concluding that she could not do math. She continued:

> For a while I did a lot of things that were applied math because I ran a radio station, and I did all sorts of things that required a lot of mathematics. So I actually learned a lot of mathematics from necessity. After I quit with the radio thing, I really had enjoyed the accounting part of what I did at the radio station, so I started taking accounting classes and took quite a number of them before I decided that both [my husband and me] being in accounting was crazy because our kids just never saw us from January to May.

She stated that she later learned to enjoy mathematics. When asked to elaborate, Shirley continued:

> It was working with decimals and percentages and ratios and graphs and linear relationships and all that kind of stuff. So the practical application of it. It made sense.

Shirley did not indicate one short episode as a turning point. However, over time she began to identify as competent in certain mathematics content. In content-based turning point stories the turning point involves a new conception of mathematics as a discipline (Drake, 2006). Because Shirley previously saw mathematics as useless but began to see it as useful, I call this gradual change in Shirley's perceptions a *content-based turning point.*

Shirley left accounting school to pursue elementary teacher certification. She said:

> I didn't need to take any more math except for the one class that I had with [the university]. I can't even remember the name of it but it was teaching mathematics. It was actually a math class... And I enjoyed it.

Shirley now enjoyed mathematics in a different context. One hallmark of a turning-point story is that the storyteller has come to see mathematics as something to be enjoyed.

> Shirley described her ongoing interest:
> If you were talking about my time when I was actually taking mathematics classes I would say disinterested [in mathematics]. Now that I'm teaching math I am obsessed...Right now I'm trying to teach kids about multiplying fractions....so I am just obsessed with pictures, of drawing pictures, trying to show them.

Shirley had developed different conceptions of mathematics and of herself, and reportedly participates in mathematics differently than before. Therefore, Shirley's story is a turning point story.

Direct identifying statements and figured worlds. Shirley's direct identifying statements are in Figure 3, along with the figured worlds she was discussing when they were uttered (in italics).

Table 5. Shirley's Direct Identifying Statements and Figured Worlds

Identifying Statement	Figured World
As a person or teacher (in general)	
I always thought I wanted to be a teacher.	Schooling
I can do science.	Her classroom
I'm on stage.	Her classroom
I'm willing to put in the time.	Her classroom
She said, "You're too controlling," and I said, "No, I'm eliminating wasted time."	Her classroom
Yes, I am controlling. That's true.	Her classroom
[My colleagues] probably think I'm silly because I make myself a lot more work.	Her school
So I'm sure [my colleague] thinks I'm foolish because his job is much easier.	Her school
I'm resentful that, and it's stupid, it's my fault. I'm resentful that more people don't do more.	Her school
I've always taught in University Heights.	District
As a mathematics teacher	
And I think I can hold my own with sixth graders.	Her classroom
Now that I'm teaching math I am obsessed.	Her classroom
If I were describing it now I would say excited.	Her classroom
Totally obsessed.	Her classroom
I really want to do the best job I can, so I'm always looking for other things.	Her classroom
And so I am just obsessed with pictures, of drawing pictures.	Her classroom
I'm always looking for some way to get them excited.	Her classroom
I'm always making them get up and stand, you know, stand up, sit down. Do, move around the room. Demonstrate it, model it, do all this stuff.	Her classroom
I'm demanding. I require them to keep working until they understand it.	Her classroom
But I think that's why they would probably think I'm demanding. And I'm always saying, no, you know, you need to do more.	Her classroom
I am a work in progress.	Her classroom
I know what I expect of them I'm more comfortable with the process.	Her classroom
That was my qualification was that I was here. And I could teach math.	Her school
I'm a book junkie.	Math PD
I'm self-taught.	Math PD
As a math person	
If you were talking about my time when I was actually taking mathematics classes I would say disinterested.	Math class (student)
I never dreamed that science or math was something I should ever even look at.	Math class (student)
I was one of the ones that was slacking them down back when I was in high school, for sure.	Math class (student)
Just being one of the struggling students myself.	CI PD
I knew I might be responsible for sharing.	CI PD
I was one who didn't know it all.	CI PD

Shirley directly identified as a competent mathematics teacher. She constructed herself as a self-motivated, self-taught learner and seeker of mathematical pedagogical tools, in contrast with her colleagues.

She made fewer direct identifying statements about herself as a math person. In those, she identified as "disinterested," "slacking them down," and "struggling." She identified similarly in the figured worlds of the CI event and mathematics class as a student.

This complexifies the interpretation of Shirley's story as a turning-point story. She identified as a competent mathematics *teacher*, but not a competent *student* of mathematics, even within the context of the PD workshop. She identified as a mathematically competent in the figured worlds of her school and her classroom, but not in the figured worlds of her childhood school or the CI event. Sometimes she identified in ways expected of the storyteller of a failure (foreclosed) story. Her direct identifying statements and mathematics life story plot are not always consistent, which corroborates theories of identity as dynamic and context-sensitive.

Mathematics Life Stories, Figured Worlds, and Choosing to Implement CI

Shirley reported implementing CI mathematics tasks in her classroom. She reportedly changed her teaching, randomly assigning students to heterogenous groups for weekly groupworthy tasks, and implementing interventions taught in the workshop. She said:

> I allow the groups to struggle more. I allow them to work more carefully together. I give them that opportunity to talk about math in a structured way with the tasks much more than I did. I'd never done group tasks for math. I might have had them doing little tiny things, but nothing like this. Nothing like they've been doing this year.

Shirley reported that several things had come together for her, resulting in her decision to adopt CI. She had focused on studying grouping practices during another ongoing PD that year, and had heard Harry Wong (Wong & Wong, 1991) speak about the importance of teaching procedures and policies to students. She felt that CI provided structure that helped students know what was expected of them and saved time:

> I learned how to organize groups in a way that makes them efficient. And I've learned, I learned that by asking each person to be responsible and holding their feet to the fire that you will get kids to be responsible. You know, it's not a hundred percent, but it's a lot closer than it had been. This is another work in progress.

Student responsibility, structure, organization, the opportunity for every student to contribute to the group and to the class are important in Shirley's discussion of CI. These are also important ideas in Shirley's life story. These are ways of identifying that are consistent for Shirley across the figured worlds of her former school (in which she was a student) and her classroom (in which she is a teacher). For Shirley, implementing CI allowed her to express these identities.

However, using groupwork may also be viewed as contrasting with her direct identifying as "self-taught," because students are to work together interdependently. Group work also contrasts with the way she identified as an outsider among her colleagues. It is possible that implementing CI in mathematics was one way in which Shirley tried to redeem her prior experiences and providing a different opportunity for her students.

Jonathan

Ways of Identifying

Mathematics life story: Roller coaster and turning point. Jonathan's story had a plot similar to a roller coaster story (he included descriptions of both success and failure during his K-12 years). Still, most of the episodes were negative. He began:

> I wasn't very successful in elementary school or middle school and in high school they didn't make me take math. They made me take a little bit of math...I can remember being a bit lost in 8th grade. I can remember that lost feeling where there were kids all around me getting it and the teacher was trying to explain it to me. I think it was negative numbers. I remember being left behind too. I didn't get it. I can remember this one day pretty well. I didn't get it but they just kept going. So after that I tuned out because they just left without me.

Jonathan described being unsuccessful, alone, and abandoned. He also told of a success in K-12 mathematics:

> In high school I had a pretty motivated teacher who really helped me get a bit more caught up. I would have to say that was only because of him. He seemed to care more. I did learn some math. So that was good. He did give me some of the skills that I needed. He gave me a bit more confidence that I could learn math.

Although Jonathan gained a bit more confidence, I do not interpret this to be a turning point in his story. He had a positive experience with this teacher, but he did not feel competent in mathematics outside of this class. Jonathan still chose not to participate in mathematics courses for several years.

Jonathan's story does not neatly fit into the category of roller coaster stories because he includes only one early story of success in mathematics. However, this success story means that it does not fit all the characteristics of failure (foreclosed) or turning point stories either, because this one success story indicates that he had not foreclosed his mathematics identity. He also described something that might be

interpreted as a turning point: the mathematics content and methods courses required during preservice teacher education. He said of these courses:

> I don't feel at all negative about [the courses]. Partly, I was a more motivated learner. You know, when you go to college you, because you want to college... That's part of it. But those particular classes were in themselves somewhat motivating. The one was a lot of hands on, a lot of opportunities to prepare things and present them. Looking at math in a slightly, less than just textbook oriented. Using manipulatives and using crayons and colored pencils in math? My goodness. Colored things. So that was great.

In this excerpt, Jonathan described affective aspects of the class, and talked about experiences with tools. Therefore, it seemed like this could be a tool-based turning point. Therefore, it seems that Jonathan's story has elements of both roller-coaster and turning-point stories.

Direct identifying statements and figured worlds. Jonathan's direct identifying statements are in Table 4, along with the figured worlds in which each of these statements were set.

Table 6. Jonathan's Direct Identifying Statements and Figured Worlds

Identifying Statement	Figured World
As a person or teacher (in general)	
I always ask the question what can the technology do that you can't do on paper and pencil.	His classroom
I've had kids say they really appreciate that I will take time to explain things with them.	His classroom
I'm the kind of teacher...I like to have things go well and be successful.	His classroom
I've always been interested in creating lessons that are for sure engaging. I've always been interested in engaging kids.	His classroom
I think [my students] would say I'm patient. I'm a patient person.	His classroom; all figured worlds
If I were to be highly qualified to be a math teacher, I wouldn't be at a middle school. At an upper grade...So we're really considered self-contained because we're two people teaching teams.	His school/his district
We're pretty lucky.	His school/his district
So you are a collaborator whether you like it or not.	His school/his district
We have direction.	His school/his district
We're a standards based report card.	His school/his district
I have always taught in Cornerstone	His district

Table 6 (cont'd)	
You were just an elementary teacher. You weren't a math teacher or science, you were everything.	Schooling (adult)
I'm 46, so I'm quite a bit older than you.	Multiple figured worlds.
I'm an early adopter, it seems like, in just about anything.	Multiple figured worlds
There's just something in me that likes to breakdown those stereotypes.	Multiple figured worlds
I'm willing to be reflective and look at what works.	Multiple figured worlds
I'm a risk taker so that helps. I'm willing to try things.	Multiple figured worlds
As a mathematics teacher	
(Students) do recognize me as a math teacher. As opposed to being a teacher in general. I think they think of me as their math teacher.	His classroom
I've been willing to tolerate, if that's he right word, I'm not sure, willing to tolerate kids being at different places, far different places, in the group.	His classroom
I would consider that as being patient.	His classroom
I see myself as someone who's willing to take risks with math teaching.	His classroom
I see myself as a teacher who wants to bring everyone into the math, and at the same time, challenge.	His classroom
I've been really, I guess strict is the word, really strict about making sure that everybody in the group sort of gets it before they can move on.	His classroom; CI
I have some appreciation having been a struggling student.	His classroom; math class (student)
[Another teacher] always refers to me as the math guy.	His school
It's not an easy job. To be called the math teacher.	His school
I'm actually the math and social studies teacher but I sort of identify myself more *His school* as the math teacher.	His school
I like that idea that I'm the math teacher and I like the idea that we at our school are also in a way the curriculum people.	His school
I was hired to teach elementary school and part of that was to be a math teacher.	Schooling (adult)
I love that title, to be a teacher of fifth grade mathematics.	Schooling (adult)
As a math person	
I wasn't very successful in elementary school or middle school.	Math class (student)
I can remember being a bit lost in 8th grade.	Math class (student)
I remember being left behind.	Math class (student)
I was able to tune out.	Math class (student)
Adrift. Adrift at times.	Math class (student)
Unsupported. I didn't care	Math class (student)
My 8th grade teacher, Sister Jane I think, she didn't think I could learn math either it seemed.	Math class (student)
I didn't think I could learn math.	Math class (student)
I was a person who didn't have as much success with math so I should have though.	Math class (student)
I continue to be a learner of math.	Multiple figured worlds
I've had to be self-taught in many ways, mathematically.	Multiple figured worlds
And the collaboration, the collaborative aspect allowed me to be successful at the task.	CI PD
Be able to do, successfully complete those tasks.	CI PD
Being successful in some of those more difficult tasks.	CI PD
As a student (in general)	
I wasn't a stellar student through elementary school but I was a capable, I was a capable student.	Schooling (student)
I was a more motivated learner [in college].	Schooling (student)

In his direct identifying statements, Jonathan articulated connections between his ways of identifying in the figured worlds of his former school and his present classroom. Additionally, he identified as collaborator. Because CI is about teaching children to collaborate, this is another instance in which the way Jonathan identifies is parallel to his decision to implement CI.

It is also notable that, when he began to identify as a competent math person, he identified as "self-taught" (which contrasts with CI) and as a perpetual learner (which is consistent with CI). He also identified as competent in the CI course. However, he seems to identify as the most competent in the figured worlds of his classroom and present school.

Mathematics Life Stories, Figured Worlds, and Choosing to Implement CI

Jonathan told stories of implementation of almost all CI principles in his classroom:

> The nature of Complex Instruction, the way I saw it that week, was that everyone in your group is going to succeed. It's just going to happen. I don't think I had that notion. I maybe had a notion that it would be nice if everyone in the group succeeded. And the big argument everyone always seems to have when I try to have a discussion about Complex Instruction, about group work, is this idea that one or one person or two people carry the group. That's legitimate except that I don't look at it that way anymore. Everyone has a responsibility to succeed and to build this collaborative sphere. It's not an easy thing to do when kids haven't done it before. But over time they start to see. That's something, I know I experienced it that week, and I know that I've seen it in my classroom now... And there was an increase in student involvement in tasks, in groupwork.

Jonathan told stories of students' increased participation and success in the figured world of his classroom as a result of CI. These are goals he had originally articulated for his students, which CI was helping him to meet. He also described himself as successful in the CI workshop. This makes it unsurprising that Jonathan would use CI to meet these

goals. Jonathan identified as a collaborator and a teacher who wants to involve and challenge all students. Because the principles of CI are parallel to Jonathan's ways of identifying, it appears that CI was a good fit for Jonathan. He did not need to change his ways of identifying to implement CI.

Jonathan identified as being alone ("adrift," "unsupported") in the figured world of his childhood school. He reported implementing CI, the goal of which is working together, in the figured world of his present classroom. He also stated that he should have been more successful in school when he was a child, and that he wanted his students to all be successful. In his own story Jonathan correlates loneliness and failure in mathematics, and togetherness and success in mathematics. Therefore, it is not surprising that Jonathan tried to bring his experience in the CI workshop into the figured world of his own classroom.

Discussion

Previous research on the links between teachers ways of identifying and their implementation of recommendations has attempted to draw a one-way arrow from the plots of teachers' life stories to their observed implementation of reform (Drake, 2006; Drake, Spilanne, and Hufferd-Ackles, 2001). The purpose of this chapter is to sketch a more complex relationship between teachers' ways of identifying and implementation. The analysis of parallels between teachers' life-stories, direct identifying statements, and stories of implementing (or not implementing) recommendations from this PD demonstrates the complexity involved in a teachers' decision to implement these recommendations. It demonstrates three possibilities for how the teachers' ways of identifying may translate into implementation of the principles and practices taught in a

PD course. These three ways are: 1) implementation allows the performance of an identity, 2) implementation allows the revision of a life story, and 3) the narrative becomes a stumbling block to implementation (failure stories). I do not intend to argue that these are the only three possibilities for how teachers' ways of identifying translate into their choices to implement certain pedagogies or not. Also, some teachers fall into more than one of the three categories of these three possibilities, indicating that there are not hard boundaries between them.

Parallels Between Identifying Stories and Stories of Implementation: When Implementation Allows the Performance of an Identity

Sometimes teachers' ways of identifying as mathematics teachers and math people in general paralleled the language they used to describe their implementation of CI (or the decision not to implement it).

For example, Shirley identified as independent and self-reliant, and when she talked about her reasons for implementing CI she evoked language of structure and responsibility. She seemed to have focused on what CI can bring to her goals for her students (structure, individual responsibility) and placed less emphasis on other aspects of CI (interdependence and status), which the professional developers would say were more important.

Jonathan is another example. Jonathan identified as a teacher who was concerned about engaging all students in participation in mathematics class while simultaneously providing challenging content. His perception of CI was that it was a way he could improve at this. Therefore, he implemented about a dozen carefully planned CI tasks during the first school year after he took the course.

It appears that sometimes teachers choose to implement new practices because they can construct them as fitting particularly well into their previous ways of identifying. Another way to say this is that teachers choose to implement pedagogies that help them to become more of the kind of teacher they want to be. Drake's (2006) research on teachers with turning point stories alludes to this, in that teachers with tool-based turning points chose to implement the use of manipulatives (even when doing so resulted in different implementation of the reform curricula than the curriculum developers intended), and teachers with content-based turning points made changes related to how the content was presented (Drake, 2006).

This observation extends the literature on professional development by providing an alternative to the assumption that teachers who choose not to implement new pedagogies, or who implement them in ways that are different than what was intended by PD or curriculum developers, do so because they lack knowledge of the pedagogy or because they have bad beliefs about students or mathematics. An alternative explanation is that the teacher did not see how the pedagogy would help her to become the type of teacher she wants to be. According to Sfard and Prusak's (2005) definition, learning is closing the gap between current and designated identities, or becoming who one said she wanted to become (2005). If a particular pedagogy does not resonate with a teacher's designated identity, perhaps she filters it out, because she perceives that it will not help her to grow in the future.

A note of caution: I do not intend to imply that only teachers who arrive in our TE or PD courses with appropriately parallel ways of identifying will be able to implement the recommendations made in those courses. This would be a dangerous assumption, and

could lead to misguidedly pre-judging who can and cannot teach in the ways recommended by mathematics education reforms. There is evidence in this chapter to show that the experience of the PD itself can be an experience that changes the ways teachers identify. Kelly experienced a turning point (Drake, 2006) *during* the CI course. As such, the way she spoke of the changes she chose to make in her practice after the CI course were sometimes parallel with the ways she identified herself in the CI course and after it. Because the experience of the PD may change how people identify, it is not possible to predict before a PD who may choose to implement the recommendations and who will not.

Contrasts Between Identifying Stories and Stories of Implementation: When Implementation Allows the Revision of a Story

At other times the teachers invoked contrasts in the ways in which they were identifying as students in school and the ways in which they identified as teachers, or as as adult learners of mathematics or mathematics teaching, or teachers. For example, Jonathan—who implemented CI--identified as a student who was alone and left behind, but he identified as a teacher who values working together and learning from each other in groups for his students. Such contrasts in language open the possibility that some teachers adopt the teaching practices they do in order to offer their students ways of identifying that they never had available for themselves. Another way to say this is that some teachers want to provide opportunities for their students to have a turning point story.

One way to theorize this is to use the construct of figured worlds (Holland, Lachicotte, Skinner, and Cain, 2004). In Jonathan's case, he identified differently when

he described himself in the figured world of his childhood school than he did in the figured world of his current school faculty. Because he identified as a collaborator in the figured world of the school faculty, he saw a way in which his lonely childhood schooling experiences could be remedied. In his classroom, he sympathized with students on the periphery. He saw that he could open new possibilities for his students to participate in math class, so that they would have a different story to tell about their time in his classroom. Therefore, he chose to bring CI, a method of collaborative learning, into the figured world of his own classroom.

The Failing (Foreclosure) Dilemma

At still other times, the teachers' ways of identifying in other figured worlds and their stories of implementing (or deciding not to implement) CI gave conflicting messages that are more difficult to explain. For example, Gina identified as incompetent in mathematics class as a student and attributed her survival to help from others; yet she chose not to implement CI in her classroom as a teacher, even though it would afford students opportunities to get help from others.

Perhaps her failure (foreclosed) life story precluded her from attempting new mathematics teaching practices. This explanation would corroborate the results of previous work (Drake, Spillane, & Hufferd-Ackles, 2001). How this happens is still unexplained, however.

If teachers with failure (foreclosed) stories are to implement new pedagogies then, it seems as though one way this could happen is if they were to experience a turning point. So, how do professional developers go about trying to provide teachers with experiences that become turning points in their mathematics life stories? It seems that

providing a successful experience is only part of the equation. From a professional developer's point of view, Gina may have experienced some success in the CI workshop. After all, she worked with group members to complete some tasks, and was able to explain the work done in her group. The key seems to be Gina's perception that she survived (rather than succeeded) in the workshop, a perception that changed very little about how she identified.

So what might help teachers with failing (foreclosed) mathematics stories experience turning points that would help them to identify as mathematically competent? Is such a goal even plausible?

Since the ways teachers identify themselves in their mathematics life stories seems to be important, one place to start is asking teachers to articulate their stories, their decisions about implementation, and the connections or contrasts between them. Perhaps, if teachers could see these connections, they would rethink the decision to not implement the new practices. Another idea is to help teachers to explicitly author stories of the successes we see them have in PD courses. Further study would be needed, of course, to find out whether these would be useful interventions.

It seems that the decision to implement new mathematics teaching practices involves a negotiation between teachers' ways of identifying themselves at different times in their lives and in different contexts and their perceptions the goals and principles of the practices. I suggest that this is a back-and-forth type of negotiation process, whereby at times, previous ways of identifying seem to be fore-grounded, and at other times the goals and principles of the practices are fore-grounded. Sometimes these are aligned with

each other, and sometimes the alignment and integration of identities and goals is likely to take some work.

Implications for Further Study

This analysis has focused on teachers' decisions to implement CI after the CI math PD course. Through this analysis I have argued that teachers' decisions to implement recommendations from a PD course are likely to be linked to how the teachers identify themselves as teachers, in the past, in the present, and in different figured worlds.

However, sustaining implementation is another story. How is it that teachers continue to decide to keep teaching with new practices? How is it that teachers move from trying something new to becoming a new kind of teacher? And how does continuing implementation of a new pedagogy impact teachers' ways of identifying? Based on the literature and the results of Phase I of my dissertation, I hypothesized that teachers would need to do some identity-alignment work in order to continue implementing these new practices and eventually add them to their mathematics teaching repertoires. I wondered what the process of becoming "a CI teacher" might look like. Therefore, I continued this study with Phase II, in which I studied teachers' stories of teaching mathematics with CI over the course of several months. In the chapters that follow, I report on the narratives of four teachers who were implementing CI during those months.

In this chapter I reported on the results of Phase I of my dissertation. The remaining results chapters report on data collected for Phase II of my dissertation. The Phase II participants were a new group of teachers (only Jonathan was in both the Phase I

and Phase II groups). In the next chapter, I will begin reporting on the Phase II group of teachers, all of whom had decided to implement CI to teach mathematics in their classrooms.

CHAPTER 5: NARRATIVES OF IMPLEMENTATION: CHALLENGES AND PERSISTENCE

> The people were distinctly bewildered. This silent, cold man, — was this John? Where was his smile and hearty handgrasp? "'Peared kind o' down in the mouf," said the Methodist preacher thoughtfully. "Seemed monstus stuck up," complained a Baptist sister. "Of the Coming of John," (DuBois, 1903/1994).
>
> I'm beginning to find me. It's great. It is, you know, Frank? It might sound selfish but all I want for the time being is what I'm findin' inside me. *Educating Rita* (Cartlidge & Gilbert, 1983)

Overview

Learning changes how one is perceived by oneself and others. In "Of the Coming of John," when John returned home, his community perceived the new quietness that allowed him to succeed in school as being "stuck up." John needed to be a different person in order to do well in school, and doing so had changed how he identified and was identified by his community. In *Educating Rita*, Rita was so enamored with schooling that her husband accused her of having an affair. What is it that drives an individual to want to learn, despite the pain that learning can cause?

Based on a review of the literature on identity and learning, as well as on the results from Phase I of the dissertation, I hypothesized that continuing to implement CI would change the ways teachers identified, and that the ways they identified would impact the ways they implemented CI. As sub-questions for this chapter, I asked, "What are the difficulties inherent in changing teaching practice that arise from the teachers' integration of new mathematics teaching identities with their older perceptions of themselves?" and "In what ways did teachers' new identities allow them to sustain changes in their mathematics teaching practice despite incredible challenges?" In order to learn more about the reciprocal nature of identifying and implementation of a new

mathematics pedagogy, I looked for parallels and contradictions between them. I compared the teachers' ways of identifying with what they said about implementing CI in interviews before and after they had implemented individual CI mathematics lessons in their classrooms.

In this chapter, I report on teachers' stories about CI mathematics lessons collected in individual interviews, group discussion sessions, and presentations to people outside of the CI experience that I collected these in Phase II. During that Phase, I followed four teachers from both cohorts of the PD course (Glynnis, Joanna, Patricia, and Jonathan), all of whom had agreed that they would be implementing CI throughout the upcoming months. (All of these teachers were new participants in Phase II, except for Jonathan.) In this chapter, the narratives function to explicate the identity work that had to happen for these teachers for the new practices to become a part of their teaching repertoire.

In the results section of this chapter, I describe the difficulties that resulted when changing pedagogy necessitated an identity shift. Such situations resulted in discomfort for the teachers, which they recognized as a problem. I report on how the teachers described this problem as being located in a variety of places. I then describe the ways in which teachers' identity work motivated their persistence during these challenges.

In this chapter, I tell Act II and plot point 2 of the story of teachers' implementation of CI for teaching mathematics. A graphic representation of where this chapter fits into the rest of this dissertation story is included as Figure 6.

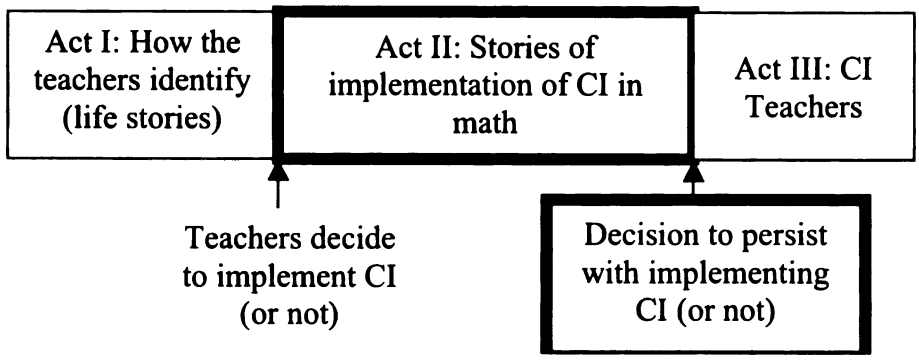

Figure 6 . Chapter 5—Act II and Plot Point 2

The Challenge: Integration and Denial of Identity

Very early in the process of data generation, I was struck by how miserable and tortured the teachers often sounded. The teachers often found implementing a new pedagogy to be difficult and painful, sometimes heartbreakingly so. Their narratives revealed clues as to how, for some teachers, implementing CI necessitated uncomfortable identity work. Teachers located the source of this discomfort in a variety of places: their own performance, the students, the CI pedagogy, or their school context.

Joanna: A Giver Steps Back

Shortly after the 2007 CI course, in which Joanna was a participant, I conducted a life story interview with her. I asked her how her students would describe her as a mathematics teacher. She said:

> I think they would describe me as being a good math teacher because I have high expectations, I push them to problem solve and to reason things through, make sure things make sense, I try to make it fun and engaging them, not just the paper and pencil or let me show you everything. Let's investigate. ... I let them know what my goals are for them as the year goes on. What I expect them to be able to walk away with. I communicate to them clearly what's gonna help them the next year, or further down the road. I don't just give them the work to have it be busy work. I explain to them the reasoning behind it. Of what we're gonna walk away with. What they'll be able to do if they learn this, how it's gonna help them later. So those things help them have understanding.

In this excerpt, Joanna said she had high expectations, but described herself as giving the students a lot of things. Joanna identified as being a teacher who *gives* a lot to students. She said she gives them goals, clear communication, and explanations of reasoning. She said that those things helped students to understand.

Later, when I conducted my first pre-lesson interview of Joanna, she identified herself as a teacher that pushes students to think. When asked if she could tell of an event in which she did this, she told the following story:

> We had this story problem: "Mrs. Garcia has taught third grade for nine years. Mr. Lee taught third grade for seven years and then fourth grade for six years. How much longer has Mr. Lee taught than Mrs. Garcia?"
>
> Well a majority of the kids had the right answer. But also a majority of them didn't show their work. It became clear to me after the first little girl came up. She wrote down her answer, and when I asked her if she could show her work she was stuck.

Joanna saw a child who was stuck, and being stuck was troubling for Joanna. Joanna had set up the problem of this story to be that a student was stuck. This set the stage for a story in which Joanna might push the student to think or to solve a problem. She continued:

> So when they get stuck I always say, "Ok, you can have a friend come up and help you." So the friend came up and helped. This is what they got. "Well, nine take away five equals four. Let's see. What else equals four? Five take away one equals four, and ten take away six equals four."

As Joanna continued the story, we again see her describing herself as giving to students to effect student understanding. Joanna saw a child who was stuck, and being stuck was troubling for Joanna. She portrayed herself as again giving something, this time the support of a friend. She identified herself as a person who "always" does this. She continued to tell the story:

> I thanked them for sharing that. Then we went through and said, "Yes, each one of those does equal four. But boys and girls," I asked the class, "Does this match the story problem?"

Joanna identified as a teacher who thanked children for sharing, even though what they shared was not what Joanna expected (i.e., not correct). In doing so, she identified as a person who was appreciative of students' efforts. As she continued the story, she told of her attempts to correct the students by giving something once again, this time a question. When Joanna continued the story, she described more students as having trouble explaining their answer. Then she continued:

> And then somebody shared, "No, that doesn't match." And they explained why.
>
> So then we had another student come up, and she had the right answer too. She came up and wrote her answer, but she couldn't show her work either. So I said, "Well, tell me how you solved it," and she told me.
>
> She said, "Well, I started at seven and I counted on with my fingers. Six more."
>
> I said, "Oh, well. Counting on. What is that?"
>
> She stood there and thought about it for a minute. Then she said, "Well that's adding."
>
> I said, "So we could make that into an equation, a number sentence. That's seven plus six equals thirteen. Let's write that down."
>
> ...
>
> So I said, "So really, you were looking for that missing number. You started at nine and you went up to thirteen."
>
> I said, "So you were filling in this missing number. This is one way you could've written it. Then I went on to show her, "Or some people might have thought of writing it as a subtraction problem."
>
> We went on to try to talk about, "How else could we do it if we wanted to show our work?"
>
> "We could draw a picture."
>
> "Do tallies," somebody came up with. So we showed an example of that.
>
> Then somebody else said, "Well, I like to put it in words. So we did an example of how they could put it in words.

Joanna portrayed herself here as *giving* something once again. This time, she was giving formal language for students' informal reasoning. Students are portrayed as becoming

able to understand as a result of her giving. In fact, they were then able to come up with some interesting ideas about how to represent the problem.

In this story, Joanna had constructed the problem as the students' inagility to explain their answers. As the tension in the story builds, Joanna portrays herself as giving a number of things: support, a friend, thanks, pointed questions, formal language, and another representation. The resolution is that students understand, and are able to then construct interesting ideas about representing the problem. In telling such a story, Joanna had identified in a number of ways, but key one way is as a *giver* whose giving resulted in student understanding. Being a giver had been a way that Joanna had identified as a successful teacher.

When I asked Joanna how her students would describe her as a teacher when she was teaching with CI, she responded:

> How would they describe me? I don't know. I think they feel that they want more information from me. I think that they feel like I don't give them enough. Because I want them to do the problem solving and they don't want that. They want answers right up front. They want me to give them more. So I think that they get kind of frustrated that they have to do that work on their own. Because so much in everything else that we do, we do so much modeling, explaining to them and prepping them. Then, when it comes to doing something like this, we set them up to do it on their own. It's opposite of what we do the rest of the time. I think that they get frustrated with that. I think that they would say I don't prepare them enough for what they're going to do.

Of course, there is nothing inherently wrong with giving. Teachers' should give students clear explanations, provide students with formal language for their reasoning, and facilitate students' understanding. However, when Joanna began to implement CI, this way of identifying became a hurdle for her. In the CI course, teachers are taught to step back and observe students for a long time before intervening in groups. Interventions are

engineered to promote students' autonomy from the teacher and interdependence on each other. Joanna had identified herself as a giver, and told stories of giving as a successful part of her teaching practice. Now, stepping back and allowing children to struggle required her to behave in ways that were different than how she identified. This was uncomfortable for Joanna. She located the source of this discomfort in her own behavior, which she perceived as troubling to the students.

Later in the interview, Joanna expressed the magnitude of her discomfort:

Joy: What are you wondering about?
Joanna: Honestly?
Joy: Mm hm.
Joanna: I see value in it but I wonder. Is it worth the effort?
Joy: Mmm. Mm hm.
Joanna: I know, there's value in it but, when I look at the chaos, and all the work, I really question. Is the effort worth what the benefits are?

It was so uncomfortable that Joanna questioned her commitment to CI. This difficulty arose because the behaviors CI requires came into conflict with her identity as a math teacher. Because Joanna had strongly identified as a mathematics teacher who achieved success by giving, she now wondered whether CI—which did not allow her to "give"—was successful enough to continue. She located the source of her discomfort in the CI pedagogy.

Joanna decided to continue to use CI. To do so, she employed some strategies to cope with this discomfort. At first, these seemed strange to me. For example, for one CI task, she tried to give her third-grade students a long list of written instructions. Later, she wondered why she thought that would work. However, considering the work that Joanna was doing to integrate her old way of identifying as a giver with her new intention to step back, this move makes sense. It allowed Joanna to give (a long set of directions) and step

back (because she expected to not need to physically intervene to give directions). If I had done a traditional pre- post- study of Joanna's learning from the CI course, and I had returned to Joanna's classroom for a post-course observation on the day that Joanna had given these directions, I may have concluded that Joanna did not learn from the CI course. However, in studying the ways in which learning CI required Joanna to integrate this new way of being a teacher with her existing ways of identifying , a more nuanced, interpretation is possible.

Several weeks later, she observed an interaction in her classroom that helped resolve some of these issues for her:

> The first table that I went to happened to be this table that I had the microphone at. And the one little girl was showing the other little girl what symmetry was. She was helping her. We talked about, in our rules, being a helper doesn't mean giving the answer. And she took the paper clip that their stuff came in, and she was just showing her like this. [Holds the paper clip on the line of symmetry of the figure.] I thought that was so cute. That was so clever, and easy way to show her, without bending up the cards or anything. As I was walking around, I noticed there were a couple other tables.

In order for Joanna to identify as the kind of teacher who steps back and lets students struggle, she needed to do some difficult identity work. Joanna told this story on subsequent occasions as well. It was an important story for integrating her older, deeply ingrained identity as a giver with her newly emerging identity as a teacher who allows students to learn from each other. Joanna had a story of success to tell about a time when she stepped back and allowed children to work together. She describes the student as inventing a pedagogy that she herself had not discovered. In stepping back, Joanna had given something new to her students—the opportunity to learn from each other and draw on each other's competencies. She had also seen how students could give to each other

things she could not necessarily give them. She used the words "showing" and "helping" to describe the student as a giver.

Jonathan: An Insider Experiences the Periphery

In Jonathan's life story interview, he said:

> They trust me a lot and I trust them. We have a lot of meetings every year so we're pretty lucky. We have these Wednesday early releases, twenty-eight of them, throughout the year. The students go home at 1:10 and we end up with an hour-and-a-half of professional development time. Twenty-eight Wednesdays... And we did a lot of things like creating common unit assessments and looking at some student work. So I would say that we had a very collegial, a lot of sharing. So there wasn't anyone that wasn't sort of equally trusted. And it was a format where you couldn't just sort of show up and disappear, because it's a small group. There are eight total fifth grade math teachers. In the building, sometimes we had a building level meeting so sometimes just 4 people. So you are a collaborator whether you like it or not. I think it just has to happen. But just given the amount of sharing that takes place in terms of the workload. I think just that in itself speaks to how we view each other. Since we all share in sort of products. We create products together. We have this great book now that has all our units laid out, and we're working on some anchor projects now...It's really great. It's really great stuff that we're doing.

Jonathan spent significant time talking about himself and his colleagues as a team. In this excerpt, Jonathan identified as a collaborator. He described his relationships with his colleagues as being collaborative. He also indicates that this collaboration has been successful, saying that they are doing "really great stuff".

As with all of the teachers, this is not the only way Jonathan identified. He also identified as a person who was interested in equity and social justice, and in motivating students to engage in challenging problems. We would like teachers to identify themselves and their colleagues as teammates and collaborators, the way Jonathan did.

In his second pre-lesson interview, I asked Jonathan what was lost in implementing CI. He stated:

> There is one thing that is lost—an understanding from my colleagues. Not everybody knows what I'm doing. And not everyone values what I'm doing because they don't fully understand it. And so I lose a little bit. As much as I wish I could tell them. Deeply, I mean...The sort of response I get is, oh yeah I, I've done group work. That's group work. That's, oh, they're calling it Complex Instruction? Oh, yeah, they always change the name of things, you know, one thing is this, and then it comes around again, every so often as another, reinvented. It's hard to explain to them that it's, yes it is group work, and it does have many elements of what they know as group work, but it's a lot more than that. So, yeah. There is that loss of understanding.

Jonathan's way of identifying as a collaborator seems at first blush to be a good match that would make for a smooth adoption of CI to teach mathematics. Unfortunately, in this case, becoming involved in CI created a small rift between Jonathan and his colleagues. Because Jonathan identified as a collaborator, this rift created a tension for Jonathan, and required some difficult identifying work. Jonathan experienced a shift in the ways he identified as a colleague. Implementing CI, and talking about it with his colleagues, changed the way he could participate with his colleagues. He identified as a team player and someone interested in equity and rigor, all important in CI, so implementing it did not require him to act very differently within the classroom. But his way of identifying in the figured world of his colleagues was challenged because he felt like his colleagues did not understand all that he was doing or his reasons for doing it.

This situation was uncomfortable for Jonathan. In the course of data collection, I was unable to see any real resolution to this problem. However, as I will describe later in the chapter, Jonathan also identified as a risk-taker and a teacher whose primary goals were equity, social justice, and rigorous learning. Because those ways of identifying aligned well with the goals of CI, Jonathan did not need to change how he identified in

that area. Therefore, he continued to implement CI, even though his identification as a collaborator continued to be challenged.

Glynnis: A Non-Conformist "Tweaks" CI

Like the others, Glynnis did not identify herself in only one way. However, in order to describe the challenge Glynnis faced as she began to implement CI, I will tell about one way Glynnis identified herself—as a non-conformist or dissident. Glynnis used this way of identifying in her life story interview. As she described how she learned to teach mathematics, she said:

> I began to feel a lot more comfortable with my adequacy in math. Beginning to take a lot more risk and trying to understand it. I was very much relieved to learn it's not about the right answer, it's not about, this whole block of knowledge here that you have to grab hold on. It's an evolutionary kind of thing, it's growing it's evolving, and it's not done. It's not ever done... When I first started teaching there was not all the dogma for tests and standards, so I was able to really grow and learn and do some things that were comfortable for me, and not feel that I had to be, da da da da da [gesturing with a vertical hand motion on each "da", to indicate a row]...it became difficult because the stringent, prescribed, curriculum began to change our [a study group I was in] focus and our shift began to not be so much on learning, exploring, investigating, as it was on preparing kids to pass the test. And like it or lump it, that's part of the mandate. If I want to stay I have to do it.

In this excerpt, Glynnis identified as interested in investigation, learning, and exploration. She positioned herself against policies that would require her to align herself and her teaching to a state standardized test. She continued:

> I don't think, you can expect kids to, produce. It's a contradictory term. Is the expectation for you to produce? Or is the expectation for you to grow and learn and develop? If the expectation is for you do develop, you don't always get a product. You don't always assess a product....While I may adhere to a different philosophy the reality that these students face is, they get told, we get told, you didn't produce, if the scores were not and AYP is not in a certain percentile.

Glynnis described herself as having a different philosophy than the state or her school administration. She identified as having different goals for her students than the district and the state had for them. She continued:

> The best that I can do, given these circumstances and these constraints, with the development of my kids is to do the da da da da da [Gesturing with vertical hand motions indicating a row] so that they won't feel totally inadequate. Because they are being measured by yardsticks, socially and politically. I tell the kids. I gave them a spiel already. " [The test is] not important, except people are going to judge you based on it. So therefore, you have this responsibility saying, 'Yes I can'. And you can. You can.
>
> You don't have the same opportunities as certain kids have had. As an urban school, that's the reality. Most of us", and I did this whole, upper class middle class, lower class, thing. I said, "How many of you heard this 'upper class', word?"
>
> A few of them had. "What do you think it means?"
>
> "It means you got money." They can recognize even at 10 that people that have money usually have something else—prestige and power. And if you don't have that money, you don't have the same prestige and power. You already know that there's a difference.
>
> "When I say rich what do think of?"
>
> "You got a big house,"
>
> "You drive a fancy car,"
>
> "You got a lot of money".
>
> "How many of you guys fit in that category? You're not. I'm not. So therefore we don't have the same power. And prestige. That's human." So they already got that. And people here have more advantages, because they have the power to change the rules. They get to make the rules. They get to do a whole bunch of stuff [laughs] Even if they don't know it. We talked about that. So that was from whence I come, with the preparation for the [state test]. Because it is, people with more power, and money, get a chance to have opportunities... They're speaking a different language that you're going to see on the [state test].

Glynnis described ways in which she attempted to both prepare students to do well on the test and simultaneously attend to her other goals. She again identified herself as somewhat subversive to the state testing mandates, by positioning herself with her students and against the establishment. This us-against-them positioning is a way in

which Glynnis identified on several occasions. She continued to identify in this way as she described the changing demographics of her school:

> My kids are predominantly nonwhite. Predominantly middle to lower [class]. Historically, it was not like this. So that's caused a paradigm shift even, as I've been here. It used to be more white. And it used to be all upper to middle to upper middle class. We've got a lot of white flight. We've got a population of teachers where I'm the youngest senior teacher here. Most of them have been here for a long time. So they're not really accustomed, and have issues of not handling the paradigm, and it's been very problematic for me. It's been problematic in a different way for them. I was the second minority teacher here. They've had one she's down in first grade. She's been the only one, predominantly, for 30 years. Now there are three African American women here. So it has changed. It's been slow. It's been painful. It's been very, very filled with angst for me because I see what a lot of people don't see, and they refuse to admit it. It's a constant battle—how much push, how much to say, and what's the most advocacy for kids and their families. Because people don't look at it that way. They look at it as, "these parents," and "these kids," and the very negative...

One interesting way in which Glynnis identified herself happened when she said "they" (the school) had one minority teacher. She also identified her colleagues as "they" in saying that they view things differently than she does. Glynnis identified as an outsider in terms of race, in terms of philosophy, and in terms of understanding children and the changing population in her school. She said:

> The collaborative effort, in the building, the climate has changed. When I started, I wanted to do the open door, and collaborate, and, the door's closed. I'm honest enough, and shameful enough to say, the door's closed. And it's simply because, I feel, that my purpose with the students that I serve here is primary. It has to be first...No I'm not doing it. I'm not. It's not about that. Because, what I do is, I feel, life changing. Everyday. It's changing my life, and it's changing the destinies of these kids whether it's academic, social, politically. It's just that important...We are life-changing, life-influencing people. It's scary. I think real hard when I say that...When you are really one-on-one with the overall destiny of somebody—how they think, how they feel about themselves. It isn't something I want handled lightly, or irreverently. It's an awesome responsibility.

> I see a lot of [teachers for whom] it's a job. Eight to three, it's a job. Get it my way or hit the highway. You're in and gone and done. I just don't adhere to that philosophy. They've got a right to think it but I don't adhere to it.

Glynnis continued to position herself outside of her school faculty in terms of her respect for the responsibility for the profession. Because she sees her philosophy as so different from others in her building, she chooses to work alone and not collaborate. Sometimes her identifying as an outsider is in regards to race, and other times it is because of her dedication to her students.

In my first individual interview with Glynnis, she said:

> Actually and that's what I came away from the class with last year. It isn't a process that you go through and voila you get an end result. Because it doesn't work, unless those fundamental principles are in the back of your mind... in a way, that was one of my biggest frustrations in the class last year. I think it was getting to me...A process of just by doing the task and the passing out the cards, that it automatically happens. And it doesn't.

She elaborated on this frustration during the first teacher discussion group meeting.

> That's what I was having some issues, struggling with Complex Instruction. Along the devil's advocate, toward that side, is that it is, sometimes, setting the instruction up, one, two, three, A, B, C, and this is how you do it. If I have roles, and if I do this, and if I do this, then the result will be a group that's successful.

Her outsider/dissident identity presented a challenge for Glynnis as she was deciding whether or not to implement CI. Glynnis had been told about a series of instructional strategies in the CI course, including assigning roles, teaching norms for participation, attending to status, and using groupworthy tasks. However, she resisted this as a part of an organized structure that someone else imposed in the course (even though Glynnis had volunteered for the course). She described CI as being "one, two, three, A, B, C," similar to the way she had indicated that the administration at her school wanted her to do "da da

da da da". Because Glynnis identified as a non-conformist and a resister, she resisted CI, even though she had volunteered for the course, questioning whether following it as prescribed was a good thing. She even identified herself as "the devil's advocate" in the first teacher group meeting, positioning herself outside the other teachers in the group.

In the second teacher group meeting, Glynnis continued to talk about her struggle with CI as a "package." She said:

> I think that the reality of education is that, if you really buy into a process of learning and teaching, there's never one thing that does the work, for all the many reasons. You can take this package and just do it. You mentioned Lucy Calkins and I've mentioned this before, one of the criticisms now about Lucy Calkins is that teachers are feeling they have to go and say this word-for-word verbatim. Do this and do like that that. They don't have any leeway.

Glynnis identified as a person who does not like to have everything lined up for her, who likes leeway in making instructional decisions. She said paralleled CI as a "package" to a program that is scripted verbatim. Again, Glynnis pressed the group to consider whether accepting CI as a package is helpful. In doing so, she continued to identify as a person who resisted imposed standards and norms. Glynnis experienced discomfort because she perceived that CI did not allow her to be the kind of teacher she wanted to be. She located the source of this problem in the CI pedagogy itself.

The last data collection session occurred when the CI teachers met to present their CI teaching at a round table session for new teacher educators who had not taken the CI course. The teachers who participated in this study came prepared to share something about their teaching with CI and to answer questions from the instructors. In that context, several months after making the previous comments, Glynnis said this about her use of CI:

> I find a lot of merit in it, so I wanted to use it I've been a very slow upstart in being able to fully incorporate it into my practice. I keep slowly working at it though...As I grapple with it more and more, I was telling Joy, I'm starting to get that it can be tweaked for individualism. An individual style. I looked at Jonathan's tasks and that was like, "Eureka!" last year. It was like, "Ok, cool. It's not all huggy bears."...I'm learning the freedom of tweaking it. That's really big for me, because I was feeling like I had to do everything. I was really not finding the freedom to change things because I didn't know if it was still CI if you tweak it. That sounds really sticky but anyway. So instead of giving them the cubes, I put all the cubes in the bucket, and part of the task was they had to figure out what cubes they needed. That was interesting...I only had three jobs instead of four and that made the groups smaller. I think at 4th grade, I think I like that much better. I told them today there would be sometimes four, sometimes there'd be three. But since this was our first time I started out with three.

As she began to see that she could continue to be non-conformist and implement principles and practices of CI, she began to be more comfortable with it. When she went to the teacher discussion groups, she realized that all of the teachers in the group were doing things a bit differently. Patricia had designed new roles and role cards. Jonathan had designed tasks that did not require the use of a lot of different cards and materials. So Glynnis reported that she began understand that she could use the principles of CI to design tasks that suited her. That freed her up to see CI as something consistent with how she identified.

Patricia: An Expert Sticks Her Ground

When this study began, both Patricia and Jonathan had been using CI for a year. However, Patricia had been teaching for over thirty years—about twice as long as Jonathan. She had also taught one groupworthy task per week out of one of the CI course resources (citation) during that year, whereas Jonathan had taught about a dozen groupworthy tasks he had designed or adapted himself. Additionally, Patricia taught first

grade, which was the youngest grade represented among the teachers participating in this study. When asked about her goals for students, she said:

> It's behavior. It's management of behavior. And the math will be there. The math will come. But that's because I'm a behaviorist first. You know my background's special ed. It's emotionally impaired. Behavior plans were the forefront of everything that I did. Somebody else may be looking at a different aspect. Jonathan, I understood where he was coming from because he has only so much time. [His goal has] gotta be the math. You gotta be learning something with the math, and not so much the behavior.

Patricia saw herself as a behaviorist, and described herself as learning the importance of teaching behaviors from her special education background. She also acknowledged that she would have different goals than Jonathan, because he taught an older grade, only had students for one mathematics class during the day, and had important mathematics content to teach in that time.

In my next individual interview with Patricia, I asked her to explain what she meant when she identified as a behaviorist. She replied:

> My initial teaching experiences were [that] I was a teacher of emotionally impaired kids. So you did behavior plans on everybody, to the nuance of how many times they said something, and then how do you increase that. So my focus has always been, you get the behavior in order then learning is more optimal. I certainly understand and know the opposite of that is you make the learning so engaging the behavior will take care of itself. But when you're teaching, I think when you're teaching cooperative learning and teamwork, at the very beginning it has to be somewhat scripted and it feels a little contrived. But for them to understand and have a picture in their head, of what expected behavior is, that it is, ...
>
> My working knowledge of [behaviorism]? I think about the lesson. I think ahead of what is going to be a problem in the lesson. How do I alleviate or run interference with that or preempt it before we even get started? I am forever the person who goes on the field trip having everybody in the circle here and we're having a short intense conversation about my expectations of their behavior. "Are we clear? Can we shut our eyes and see ourselves sitting on the bus, with our feet on the floor, and our knees forward? Everybody try that. See it in your head. That's where I

> want you to see." So we do imagery, and I'll do a conversation, and I'll do vocabulary so that they're clear. "Are we clear? Because I don't want you to be disappointed when we get on the bus and the natural consequence is that you cannot join the group." So my feeling always is be very up front about what is going to happen so that it is not a surprise. It's not a reaction to the moment. And so they have a heightened awareness of what is expected of them. For me to take from the emotionally impaired classroom to this kind of classroom, you don't want it as confining as I had to be in the other kind of classroom. But on the other hand, I use similar techniques. I forewarn. I give them a model. I want them to visualize it and see themselves walking through what they're going to do. "Now get up and everybody do it."

Patricia did not seem to experience the same type of conflicting ways of identifying or the need to do the types of integrating of identities that the other teachers did. Throughout the data collection period for this study, Patricia identified herself as a "behaviorist," which she described as being a person who believes that if you teach school behaviors explicitly the mathematical learning will follow. This way of identifying was comfortable for her. As the study continued and she spent more time talking with the other teachers, she conceded that the mathematical learning is a reasonable focus for teachers at other grade levels. In doing so, she positioned herself in a place where she would not need to significantly change her ways of identifying to become a teacher who was more concerned about mathematical learning during CI tasks. She also claimed that her students were learning a lot of mathematics during their non-CI mathematics lessons, but that during the CI time, her focus was behavior. Again, in making these claims, Patricia created a space for mathematics in her practice without having to integrate any new ways of identifying with her previous ways of identifying.

One reasonable hypothesis for this is that Patricia had been teaching for much longer than the other teachers. Therefore, perhaps her ways of identifying were more congealed, more solid. Another hypothesis is that she could perform her previous way of

identifying as a "behaviorist" while teaching math using CI to such an extent that she did not need to change anything. She also identified as an "expert" through her use of How-I-Teach-Math-With-CI stories (which are the topic of Chapter 6). This led me to wonder whether "expert" identities might be more reified and less likely to change than other ways of identifying (which is the focus of Chapter 6).

It is also possible that any conflict between Patricia's previous and newer ways of identifying were resolved prior to my interviews. Patricia had been teaching using CI for a year before she began participating in Phase II of the study. This was true for Jonathan as well; however, Jonathan had taught about 12 CI lessons in the year between the CI course and Phase II of the study, but Patricia had taught a CI lesson every week of the school year during that same time.

Persistence: The Expression of Identity

After observing just how challenging implementing these new practices were for teachers, I became puzzled. Why did they continue to persist in the midst of such difficulty? Thus, I examined teachers' narratives for evidence as to whether their identity work was supporting such persistence.

Joanna as Project Person

Joanna had a history of participating in mathematics professional development events, courses, and research sponsored by our Midwestern University. She came to CI because she had heard about it from a graduate student with whom she was working on another university-sponsored project. One way she chose to identify was as a person who participated in these things and then brought the ideas back to her colleagues. In that way, participating in CI suited her current ways of identifying.

I asked Joanna why she participated in projects. She said:

> I'm always looking for ways to push the bar higher and trying different things. I just don't go with the same old thing. I don't use [the textbook] in the classroom hardly. I pull in all of my own stuff from a variety of sources that I think engage kids better and get them into that learning more. [My colleagues] see that, so I think because of that they think that I'm a good math teacher.

Joanna identified as a teacher who was interested in continuing to change and try new ideas. This was why she continued to get involved in university-sponsored PD and research. Joanna identified as a person who had and used a lot of interesting resources. She perceived that she was viewed positively because of this. It makes sense, then, that Joanna sought out CI as a place to learn new methods and gain new resources. Later, she said:

> I think [my colleagues] just look at me as being the person that's always trying new things and willing to say when something doesn't work. Willing to say when something goes really well. I always share my ideas but a lot of times they don't want to do it because they think it's too much to take on... Some of them, I think, are impressed and they wish they had that time or that energy. We're all in different places to do that or that comfort zone. Some of them just aren't comfortable with it.

Joanna wanted her colleagues to identify her as dedicated, willing to try new things, and energetic. Thus, she indicated these as values she has taken on herself, but are also valued by her colleagues. When I asked her about her motivation for trying new things, she stated:

> For me it's that I'm really trying to be a more effective teacher and this is my way of doing it. I'm not good with just doing the same thing all the time. I'm always trying to better my practice

The way Joanna described herself as seeking to better her practice is through getting involved with projects and PD events. When I asked her to describe herself, she was quick to respond:

> I'm not satisfied at all. I always feel like ok I could do a lot better than I'm doing, or cover a concept a lot better than we covered, or maybe I'm the one that's causing this disconnectedness because I'm not allowing enough time or, what is a clear connection for me maybe isn't for my kids. No. I'm just always feeling that I can change or do better. Always. I never feel fully satisfied...I could do better myself or understand more ways...As my daughter would put it I'm a workaholic and I'm just always driving myself to do more. I'm just never satisfied with the status quo.

In this excerpt, Joanna continued to identify as driven to learn more and new ways of teaching. At the core seems to be a sense of dissatisfaction with her own competence.

Joanna identified as a teacher who was a joiner when it came to University PD and projects as the one who tries new things. She identified as dissatisfied with her competence and always wanting to learn more. As such, it is unsurprising that she joined the CI course (which was sponsored by the University) or that she volunteered for this research study.

It also may explain part of the reason she continued to implement CI, even when it was difficult. In doing so, Joanna could continue to identify as the teacher in her building who was trying something new, who was striving for something difficult, who was a "workaholic" working on bettering her practice.

Jonathan as Rigorous and Inclusive

Jonathan stated that he is motivated by a desire to empower students by helping them to understand the world through mathematics. He said:

> I see myself as someone who's willing to take risks with math teaching. Who wants, I want to find ways that reach more kids and I want to find ways, I see myself as a teacher who wants to bring everybody into the math, and yet at the same time challenge...I want to be successful. I want kids to be successful. I think that's probably at the core. There's a great satisfaction in seeing kids learn. And so I mean just there's a self-satisfaction in watching kids get it, and becoming. There's power in knowing things too. I have more of an awareness now when I see things like people offering bargains that aren't really bargains, you know. Or you

> know looking at data in a way that people say things are the way they are but you look a little bit deeper in the data you look at the statistics and they're giving you a false claim. So you know I like that idea of helping people see that and getting power from that. I think stereotypes have changed a bit, but there used to be a time when it seemed like guys would be the mathy students and girls, oh, they'd be the readers and the writers. But I like that that I can say that the smartest student in the class is a girl, you know. I don't know why that is. Maybe because I have a daughter. But there's just something in me that likes to breakdown those stereotypes.

Jonathan identified himself as a risk-taker, especially for the purposes of teaching more children and facilitating student learning. The central goal of the CI course is promoting both equity and rigor in mathematics classrooms. Therefore, participating in the course and implementing CI in his classroom was a way that Jonathan could identify as an equity-minded, rigorous teacher.

As Jonathan implemented CI, he continued to assess whether or not it was helping him work toward his goal of being an equitable and rigorous teacher. In a post-lesson interview, he stated:

> I see kids able to show me things they wouldn't be able to show me in other ways. I think they get deeply engaged in group tasks, much more than a lot of the work I give them. I can give really meaningful, challenging work that is supported. I'm twenty-seven [students] this year in both my sections, which is big. If I had to go twenty-seven-on-one, with complex stuff like this, I'd have a lot of frustrated kids. I'd have a lot of kids that didn't get my time, that wouldn't get help, that wouldn't get as much feedback. Those times that they are in group task there's a lot of deep thinking, there's a lot of sharing, there's a lot of strategizing.

Jonathan continued to implement CI because doing so allowed him to identify as a thoughtful teacher who continued to be concerned about rigor, while supporting all students' learning.

Glynnis as Subversive

Glynnis identified herself as a dissident who saw injustice in the system and intended to fight it. She believed that high-stakes testing policies and the ways test scores were reported and used in her urban school was unjust. Consider the following excerpt from Glynnis' life story interview:

> Glynnis: I believe every human, every teacher, has a desire to impart some kind of thing. Mine isn't what every other teacher's is. They've got desires too. I recognize those. They desire for everybody to conform.
>
> Joy: What would you name your desire?
>
> Glynnis: Hm. Good question. What would I name it?
>
> Joy: You know that it's different than conformity
>
> Glynnis: Yeah.
>
> Joy: And different than what other folks are-
>
> Glynnis: It is, mine is, to use a cliché, to empower. To empower with identity, to empower with a voice, to empower with responsibility to change, to empower with the ability, the responsibility to question. Because even if you don't change you really have to question, "Is this right?" So that's what I do. The status quo. Why is it the status quo? Why do kids have to sit in chairs? Just because. Why is it that girls have to wear skirts and why is it that boys, you know. You have to question those. And if you question them, you get to decide, do I want to conform? Or do I want to be different. And being different sometimes costs.

As much as her identifying as a resister caused Glynnis to struggle to accept CI, this also motivated her to persist with CI in mathematics. In the context of a story about preparing her students for the standardized test, she said:

> I think we do a remarkable job at trying to give substantive, I call it a form of resistance. Closing the door. Doing this project. Doing CI.

Glynnis made it clearer that it was this way of identifying that motivated her to persist with using CI in her classroom. Because it afforded her the opportunity to identify as a resister, she was motivated to persist through many difficulties.

Patricia as Organizer of Materials and Behavior

One way Patricia identified was as organized and orderly. Her method of implementing CI after the course was to use one of the resource books that contained tasks (LHS, yr). She began at the beginning of the book, and worked through it, one activity per week, in order. In order to prepare to do this, she asked parents to copy the activities, color-code them according to groups, laminate them, and file them according to her system. When she spoke about her use of CI in the first pre-interview, she said:

> I color code because it's so much easier to find the pieces and put them back. So, it ends up being not difficult to do...Once they're made up it's easy to set up. They're responsible for getting their stuff and, and taking it back to the table, I have a chart that rotates their jobs and easily rotates their roles.

Using CI in this particular way, using these particular tasks, allowed her to shine in the area of organization. Also in the first pre-interview, she said:

> At the end of April, I'll reorganize the groups again. I keep the chart like that and I just move the jobs to the next person so it's all set to go. I keep it turned around. The orange ones have the actual job names on them. I put the colorful cards up just before I send them out. Otherwise they're all going, "It's my turn."

Patricia created sets of color-coordinated, laminated role cards with pictures so that students could learn and use roles. She set up a chart with color-coordinated cards to help keep the groups organized from week-to-week. Patricia identified her color-coordination schemes as being about simplicity and organization.

Patricia saw another reason for her use of color. She said:

I'm also a first grade person so I like, I make things bright.

She also identified as a teacher of young children, which she claimed was another reason for organizing materials by color. Color-coordination and organization of materials were skills that Patricia identified as strengths. Some of the teachers were overwhelmed by the new and abundant materials; however, Patricia enjoyed that part once the materials were made.

As you recall from earlier in the chapter, Patricia also identified as a "behaviorist" (her term). She said:

> It's behavior. It's management of behavior. And the math will be there. The math will come. But that's because I'm a behaviorist first. You know, my background's special ed. It's emotionally impaired, and behavior plans were the forefront of everything that I did

Patricia had previously been a special education teacher, and identified that experience as her reason for being a behaviorist. When I later asked her what it meant to her that she was a behaviorist, she replied:

> My initial teaching experiences, I was a teacher of emotionally impaired kids. So you did behavior plans on everybody, to the nuance of how many times they said something, and then how do you increase that. So my focus has always been, you get the behavior in order, then learning is more optimal. I certainly understand and know the opposite of that is, you make the learning so engaging, the behavior will take care of itself. But I think when you're teaching cooperative learning and teamwork, at the very beginning it has to be somewhat scripted, and it feels a little contrived, for them to understand and have a picture in their head, what expected behavior is...I think about the lesson. I think ahead of what is going to be a problem in the lesson. How do I alleviate, or run interference with that, or preempt it before we even get started? I am forever the person who goes on the field trip having everybody in the circle here and we're having a short intense conversation about my expectations of their behavior. Are we clear? Can we shut our eyes and see ourselves sitting on the bus, with our feet on the floor, and our knees forward? Everybody try that. See it in your head. That's what I want you to see. So we do imagery, and I'll do a

> conversation, and I'll do vocabulary so that they're clear. Are we clear? Because I don't want you to be disappointed when we get on the bus and the natural consequence is that you cannot join the group. So that, my feeling always is be very up front about what is going to happen that is not a surprise. It's not a reaction to the moment like this, and they have heightened awareness of what is expected of them.
>
> To take from the emotionally impaired classroom to this kind of classroom you don't want it as confining as I had to be in the other kind of classroom. But on the other hand, I use the same, similar techniques. I forewarn. I give them a model. I want them to visualize it and see themselves walking through what they're going to do. Now get up and everybody do it.

The model Patricia described may not align with other conceptions of what behaviorism is. For her, it is about giving students a clear image of the expected behavior and then expecting them to behave in the ways she has stated. It is unsurprising, then, that Patricia's main stated goal for using CI was to help students to learn behaviors for certain situations.

In the teacher study group, Jonathan had been wondering about the usefulness of assigning roles to students. In response, Patricia said:

> I'm going to play devil's advocate for this. If we think in the real world as adults, who sit in a team meeting, the roles blend themselves. You tend to be the person in the meeting that you're most comfortable with. You may have a different, that you want to be the cheerleader and it seems to involve itself. But one of the things that we frequently hear business and real world people say is we're graduating people who do not know how to work in a group. The struggle of, let it go and leave it the way it is, and the natural leaders will continue to be natural leaders, the children that are hitchhikers will continue to be hitchhikers and stand in back letting other kids go with it. Even though you want to teach the mathematics part, the role part is integral in that because when else do they have the opportunity to really get into something different than who they are. Who they naturally are. So, if I have one child who's the natural cheerleader, but never volunteers to clean up and never volunteers to pack up, I'm not giving that opportunity for them to begin to learn that role...Now, in an ideal world, starting at first grade I emphasize the role, but we still do math, but the math is not the emphasis. By the time you get to fifth grade you deemphasize the role because you don't need, to do it as much

> because you've blended those kinds of things. But if they've never done it, then they're never going to have it.

Patricia stated that her goal for teaching roles to students is to teach them behaviors that are valued by the business world, which the students themselves might not gravitate toward or volunteer for. She justified her continued use of CI:

> I'm amazed. Within the first month they are independent...They're responsible for their own clue. They have to get along with each other. They have to listen to each other...The group tends to monitor themselves. It is pretty amazing to sit here and see them do that. The gym teacher came in. the gym floor was being finished so that room across the hall is empty. He's in between classes so he came in, and he says, "I have to tell you how amazed I am."

Patricia continued to evaluate her use of CI to see whether it was helping her to meet her goal of teaching behaviors that are privileged in school and business. Patricia was pleased that, by implementing CI, she had taught her students to behave in ways that impressed another teacher. It is true that, in the CI course, teachers have a lot of opportunities to learn about a variety of instructional strategies and interventions. By color-coding and filing materials, Patricia was able to identify as an organizer of materials. By giving each student a role and enacting other CI instructional strategies, she was able to identify as a behaviorist and organizer of students in her classroom. This was a reason for Patricia to continue to implement CI.

Discussion

The data in this chapter speak to the second research question for this dissertation, which was, " How do teachers' ways of identifying become obstacles (or aids) to teachers' attempts to change their teaching practice? How do they make sense of the obstacles and overcome them?" I have described ways in which changing their practice necessitated some teachers' integrating new ways of identifying with previous ways of identifying. I

have described how this identity work was often an obstacle, and how some teachers worked to overcome the obstacle.

It has been repeatedly argued in the literature that teacher change is difficult, and that PD events fail to effect change in teaching practice. Often the result is interpreted to mean that teachers are unable to learn, and/or PD is ineffective. This interpretation of the data overlooks the complex processes involved in learning reducing change to the simple decision to implement new practices. One longstanding explanation for the stability of teaching practice is the apprenticeship of observation theory (Lortie, 1975), which says that teachers teach in the ways they were taught. However, this explanation does not account for instances where teachers do learn and sustain new pedagogies. It appears that the identity work that a teacher must undertake in order to include new teaching pedagogies into her practice can be significant and difficult for some teachers. As evidenced in the cases of Joanna, Jonathan, and Glynnis, changes in practice often require changes in identifying, which can be painful.

As sub-question for this particular chapter, I asked specifically, "What are the difficulties inherent in changing teaching practice that arise from the teachers' integration of new mathematics teaching identities with their older perceptions of themselves?" and "In what ways did teachers' changing identities allow them to persist in making changes in their mathematics teaching practice despite incredible challenges?" I will address these two questions in the next two sections.

Difficulties of Identity Integration

Identity integration happened very differently with each. In fact, in the case of Patricia, I did not see evidence of difficulty. This dissertation, however, has opened up

possibilities by presenting some varied ways in which this might happen. None of these ways should be expected to happen in every teacher or in every PD. And it is likely that there are many more ways in which the identity work necessitated by teacher change may play out in a teacher's practice.

However, it is clear that adopting teaching practices that do not align with a teacher's prior self-perceptions can be uncomfortable enough for a teacher to question whether implementing a new practice is a good idea. In such a case, how do teachers make sense of their discomfort? It seems that no teacher in this study articulated this discomfort explicitly as an identity issue, although I argue each case can be described as such. Interestingly, the teachers located the source of this discomfort in at least four different locations: 1) their own performance of CI, 2) the students, 3) CI principles, or 4) external factors, such as administrators, colleagues, or other aspects of the school culture. For example, Joanna responded that she thought her students saw her as not giving enough (locating the problem within herself), wondered whether CI was right for her students, who she described as having "strong personalities" (locating the problem with her students), and wondered whether CI was worth the time, given the results she was seeing (locating the problem with the pedagogy). Glynnis, also, responded that CI was difficult because she had not had the energy to pay enough attention during the PD course (locating the problem with her self), she had 34 students in her class (locating the problem with the students and with the administration and school), and that CI was too prescribed and rigid (locating the problem with the pedagogy). Jonathan stated that the difficulty for him came in changed relationships between himself and his colleagues (locating the problem with himself, colleagues, and the school culture).

At first glance, it appears that teachers may be trying to play "the blame game" in terms of why CI was difficult to implement. That is no surprise. In mathematics education, researchers frequently play this game. If I had conducted a pre/post study of teachers' practices before and after the CI workshop, and had come for a post-workshop observation when Joanna was giving out pages of directions, I may have been tempted to play that game as well. I may have concluded that something was wrong with the PD, or that something was wrong with the teacher, or the school, the available resources, etc. However, reframing this scenario in terms of identity has given me new ways to explain teaching practice and the outcomes of PD. Instead of placing blame, I have been able to see the identity-work as part of a longer, ongoing learning process.

If teachers had this same lens available to them, both for looking at students and themselves, what would change in their teaching? Understanding this identity-integration process better will allow professional developers to better provide support for teachers as they anticipate and work through these shifts in identity.

Performing Identities

Additionally, CI allowed each of these teachers to perform some aspect of their identities even more fully in the classroom. It allowed each of them to be more of the type of teacher they wanted to become. It is interesting that this happened for each of these four teachers, who all had very different ways of identifying to begin with. Somehow, the scope of CI as a pedagogy is to be broad enough that teachers with very different ways of identifying were able to perform different ways of identifying by implementing CI.

In a textbook used in many elementary mathematics methods courses (Van de Walle, 2006), teachers read that there are two main ways to adapt instruction to meet the needs of learners in classrooms heterogeneous in terms of ability: using tasks with multiple entry points or differentiated tasks. Tasks with multiple entry points are those rich enough to offer a variety of ways to participate. Differentiated tasks are those for which the same problem may be done in different versions for students with different abilities. Similarly, in the CI course, teachers were taught that a "groupworthy" task is a task that draws on many different student abilities. Because it draws on a range of skills, no one student in each group would be expected to be able to complete the task without the skills of others. (Cohen, 1994).

In those terms, the CI course itself may be viewed as a PD course or a pedagogy with multiple entry points. That is, teachers with a wide variety of ways of identifying found ways to participate in the course and/or implement the principles and practices of CI in their classrooms. Four teachers, heterogeneous according to how they identified as teachers, were all motivated to persist through the challenges of implementation because implementing CI allowed them to be more of the type of teacher they wished to become.

Understanding the ways certain teaching practices afford teachers' the opportunities to perform their identities will help professional developers design PD experiences that make these connections explicit and will resonate with various teachers' self-perceptions, thereby increasingly the likelihood that the implementation of the teaching new practices will be sustainable over time.

CHAPTER 6: GENERALIZED NARRATIVES: *HOW-I-TEACH* STORIES AS INTEGRATED IDENTITIES

> Thus he grew in body and soul, and with him his clothes seemed to grow and arrange themselves; coat sleeves got longer, cuffs appeared, and collars got less soiled. Now and then his boots shone, and a new dignity crept into his walk. "Of the Coming of John," (DuBois, 1903/1994).

> I believe you're doin' really well at the college now, eh? I hardly recognized you. You really look the part. Doesn't she, eh? Look the real student. You'll be on drugs and demonstration next, ah hah. *Educating Rita* (Cartlidge & Gilbert, 1983).

Overview

In "Of the Coming of John," *Educating Rita*, and in my own story, learning resulted in different ways of speaking, dressing, and relating. As the teachers in Phase II of my study were implementing CI, they began to tell a new kind of story as well—stories of themselves as "Complex Instruction teachers." Teachers sometimes told a type of story that I refer to as *how-I-teach* stories—general narrations of how they teach and students respond (as opposed to narrations of a specific event). Crespo & Juzwik (2006) studied the performative aspects of teachers' *expository* stories, which are final draft stories told without invitation for dialogue. *How-I-teach* stories are a subset of expository narratives. At various times and in various ways, they began to tell *how-I-teach-math* stories specifically about how they use CI to teach mathematics. These narratives function to claim some new teaching practices as the teachers' own—to identify them as "CI teachers."

In the results section of this chapter, I present one *how-I-teach-math* story about teaching mathematics with CI from each teacher and report on the timeline for which they emerged in the teachers' storytelling. Three of the teachers told such stories about how they go through a CI lesson or several parts of CI lessons. However, in the case of

Glynnis, she only told this type of story about one small part of a lesson. In the discussion section, I theorize these stories as narrative performances of the teachers' emerging *CI teacher identities*—that is to say that some teachers began to identify as "CI teachers" through the reification of experience into integrated (expert) identities.

In this chapter, I am telling Act III of the story of teachers' implementation of CI to teach mathematics. A graphic representation of the position of this chapter in the plot of the overall story is included as Figure 7. The scope of this chapter is indicated in bold outline on the figure.

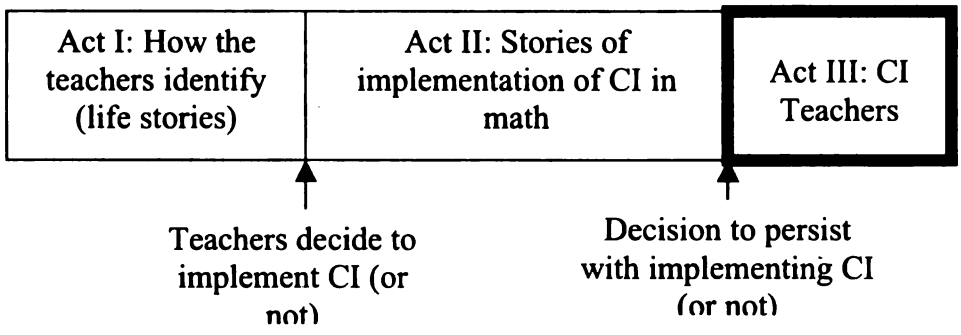

Figure 7. Chapter 6—Act III

Generalized Narratives

Patricia

As stated in Chapter 3, at the beginning of Phase II Patricia had been using CI for one school year. When I walked into her classroom for her first individual interview, she began to talk about CI before I had an opportunity to ask a question. I interrupted her and asked her if I could turn on the audio recorder. When the recorder was on, I said, "So tell me what you were going to tell me." She began:

> I use the *Group Solutions* book[7]. I walk through it from the very beginning. Actually, I don't walk through it from the very beginning. I start with jobs. I describe the jobs, and we model the four different jobs. The jobs are not listed as they are in the [the CI course materials][8]...The information on the back tells them what to do, and the model conversation that they can have is still the same on the back. But on the front I just gave the little picture, because first graders know that, so that everybody's involved and understands. The jobs rotate. The groups actually rotate too. About every six weeks I change desks, so they may end up with different people. Some kids say, "Well, I was material manager two times in a row," but it all works out in the end...We review [the roles] almost every week. And there'll be an emphasis one too. Like, I'll say, "The questioner is the person who begins, and then we go clockwise." That way, we talk more about the questioner and we ask the other people what the questioner is doing so that they're more aware of, a little bit of observation, with it...At the end, of the activity we all get together and we talk about how we solved things

This is a *how-I-teach* story about using CI to teach mathematics. At times, Patricia tells narratives using present tense terms (I walk... I describe...) indicating how she always or usually is when doing CI lessons. Remember that direct identifying statements are *reified*; that is, that they are spoken of as detemporalized objects (Sfard & Prusak, 2005). In this story, Patricia is doing something similar with her verbs. By using present tense verbs, Patricia has detemporalized her use of these practices, thus identifying herself as the kind of teacher who routinely carries out these practices as a part of teaching. I.e., she began to identify as a CI teacher.

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[7] This book of group tasks was given to teachers who participated in the Complex Instruction professional development course (Goodman, 2000).

[8] In using the word "jobs", Patricia is talking about what was called *roles* in the CI course. Roles are an important instructional strategy in CI. Students are given roles that are specifically designed to engage them in the mathematics at stake in a *groupworthy task*. The roles introduced in the course are: the resource monitor, recorder/reporter, facilitator, and team captain. However, Patricia designed a new set of roles for her students, in order to make them more usable in her first-grade classroom. The roles she designed are: the questioner, the includer, the material manager, and the cheerleader.

Jonathan

Jonathan had also been teaching mathematics using CI for a year when this study began. Jonathan told he story that follows during the first teacher group meeting. As stated in Chapter 3, teachers were asked to come prepared to share stories of using CI to teach mathematics. In the group discussions, teachers took turns sharing these stories (See Appendix C). In this meeting, Jonathan was the second teacher to share a story. (Joanna had been first. She told of some students' who violated the groupwork norms during a recent CI math lesson, and the teachers discussed possible interventions she could use should it happen again[9]). When Jonathan took his turn at storytelling in the group, he said:

> I might give the group, inside a laminated or clear sheet, this page with the other one to the back, so they can see them both. They're on a clear sheet so they don't really write on them. One of the things I've been working with is this idea of putting the math skills that that they're going to be working on the page, and then the groupwork skills that they're going to be working on below that, and then some of the materials they might need, and then I put the directions there...To back up and tell you how I do this. I don't do a task every week. I don't always do a task every month. I tend to do a task toward the end of a unit, because for me it's a really nice way to bring together a lot of new skills they've learned and share them out. Sort of showcase. Look at this, we've done, we can do this now. We can do this. We can do this. And then other people will go, yes. Yes. No. Yes. You know? And so I find it very powerful to do it like that...They're group one. I don't like names. They're strictly groups one to seven. Everybody writes their name, whatever seat they're on. And as they finish the task they are required to call me over. They don't know who in the group's going to have to explain it. And so I'm, you know...I have a little stamp, and I'll stamp [their task card], and then they can go on to the next task.

Notice that Jonathan moved back and forth between generalized and specific talk about his teaching in his first how-I-teach story about using CI to teach mathematics.

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[9] *Groupwork norms* and *interventions* are instructional strategies taught in the CI course.

Like Patricia, much of Jonathan's language is in the present tense when he refers both to how he teaches mathematics with CI (I don't..., I tend to..., I find it...) and what his students do (They don't know...,everybody writes...). Again, by speaking in this way, Jonathan identifies as a teacher who does CI, and who does CI in a certain way. He identifies as a CI teacher.

It is interesting that Jonathan did not tell a *how-I-teach* story about CI in our first individual interview, but did tell this type of story in the first teacher group. Within the teacher group, there were teachers who had only been using CI for a couple of months and teachers who had been using it for over a year (including Jonathan). One way that Jonathan and Patricia identified themselves as the old-timers to CI (Sfard & Prusak, 2005) was to tell stories that identified themselves as people who use CI and who use it in an individualized way.

Joanna

Joanna was one of the teachers who had been teaching mathematics using CI for only a couple of months when Phase I began. In the first individual interview, she said:

> [The students] don't want to follow the rules like, make sure you've talked this over with everyone in your group before you ask the teacher for help. There's always, three, somebody from three different tables jumping up that, you know, that impulsiveness they want to ask me it.

Joanna had used CI to teach mathematics a couple of times, and told this story that included the type of generalized language that is a marker for a *how-I-teach* story. However, it is not really a how-I-teach story but a story about how students respond to her attempts at teaching mathematics using CI. She only spoke in such a generalized manner about her students. She did not talk about herself in a generalized way, or identify herself as a certain kind of CI teacher. She continued the story differently, however:

> We[10] have talked about this since the beginning of the school year, we've repeated it, since, the beginning of the school year.

When she continued the story to include herself in the action, she switched back to speaking about the past. "[W]e have talked" sets her story in a specific time. Her use of past participles indicates it has happened more than once. However, she is not detemporalizing her behavior, so it is not a how-I-teach story.

However, at the last data-generation session of Phase II, the round-table presentation, Joanna told a *how-I-teach* story about using CI in mathematics[11]. I had asked her if she would like to tell the group about a task. She said:

> I start out modeling with tasks from *Group Solutions Too*[12], the other book. It gets my kids accustomed to the norms and roles by using those tasks...But I try to use other tasks too. I try to use tasks from Balanced Assessment. Something in the classroom that I'm curious about are the norms, what we just call group rules that I have in the classroom...those are, some of those things are things that we instill throughout the school day in everything that we do. They're very familiar with them but I keep them posted when we do any kind of a [CI] task...The kids, in the sharing process, they'll raise a hand and they'll ask a team, "What do you mean by

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[10] For a discussion of the use of the pronoun "we" by teachers, see Pimm, 1987.

[11] Teachers had been asked to share their work with CI in mathematics with new instructors. I began the session by asking everyone present to introduce themselves. Some CI teachers began telling stories during their introductions. Next, I put a slide on the board that stated the three important components of CI (the slide had been used in the CI course), said that I wanted to make sure the guests understood the terms we were using, and asked the teachers to explain the components. Patricia began by telling a story about how she deals with status (one of the components) and uses instructional strategies (another component) in her classroom. Jonathan followed by telling a story about how he plans tasks (the third component on the slide). Some of the teachers (primarily Patricia and Jonathan, but sometimes Glynnis) continued telling stories (both how-I-teach stories and specific stories). When there is was a slight break in the conversation I said, "Joanna, do you want to tell us about a task?"

[12] This book (Goodman & Kopp, 2007) was distributed during the CI math PD course.

> that. I really don't get it. Can you explain that to me?" There's just a lot of dialoguing that's going on...I rotate [the groups] in my grade book. I go by whatever their seating arrangement is. I just pass the cards out to each group and I just put a sticky note on and I just say, "This time you're the organizer. This time you're the captain. This time you're the recorder/reporter." I just pass them out. They just hold on to them and it helps give little reminders about what their responsibility is within their group.

Joanna told a *how-I-teach* story about using CI in mathematics. As Patricia and Jonathan did in their how-I-teach stories, Joanna spoke of herself primarily in the present tense, indicating that these are things she continues to do. While she had talked this way about her students at the beginning of the data-generation time period, she had not spoken this way about herself.

Again, it is interesting that the context and the audience are different here than in my individual interviews with her or in the CI teacher group meetings. In this context, with instructors who had not taken the CI course, Joanna identified as a CI teacher who generally used CI in a certain way. She identified as a CI expert in relation to her audience for these stories.

Glynnis

At the round-table session with instructors who had not used CI, while Joanna was sharing materials she used to teach math with CI, she mentioned that she created different names for some of the roles than teachers had seen in the CI course. Glynnis interrupted and suggested that the names for the roles in the CI course were problematic. She said:

> I try to tell the kids that everybody has a role and none of them are more important than the other. That they each are all very important roles. Because otherwise they're like, "Oh, she wants me to be the captain," and the status is already there. Because the 4th grade, especially, they've had years and years of it.

Glynnis only told this one short segment of a story of teaching mathematics with CI in which she reified her actions. In this story, Glynnis spoke in generalized terms about how she deals with one possible status problem she sees with the roles. Glynnis did not tell *how-I-teach* stories about how she did any other part of the process, including preparing tasks, organizing her classroom for instruction, or implementing instructional strategies. Again, it is notable that she only told this type of story about CI teaching in a context where she was someone who had used CI and there were people in the audience who did not. In that context, in this small part of a story, she identified herself as a person who typically deals with this issue in this way. In doing so, she has identified herself as an expert in dealing with possible conflicts that might come about because of the role cards.

Discussion

I have argued throughout that these teachers' narratives about their mathematics teaching are related to their decisions to implement CI (or not) and have explicated the identity integration work that had to happen in order for them to continue teaching math with CI. In this chapter I have shown a particular type of narrative that teachers told about their use of CI in mathematics—the *how-I-teach* stories. These narratives function to claim some new ways of teaching as their own and reify the teachers' experiences into what I refer to as integrated (expert) identities. In the discussion that follows, I posit *how-I-teach* stories as markers of teachers who identify as "CI teachers" with integrated (expert) identities.

Integrated (Expert) Identities: What it Means to Identify as a CI Teacher

The Reification of Experience: Present-Tense Verbs

As stated in the literature review, direct identifying statements are statements about a person that are reified, endorsed, and significant. A statement is said to be reified if talk about actions or processes have been replaced with talk about detemporalized objects. For example, "I gave the students a problem solving task" is not reified because it talks about an action that a teacher has taken, but "I am a problem-based teacher" is a reified statement, because the teacher is then describing a characteristic of herself as true regardless of time (Sfard & Prusak, 2005).

The stories in this chapter are not *direct identifying statements* because in these stories the teachers have not made succinct, reified statements. Reification is defined as turning actions or processes into objects (Sfard, 2008). In these stories, the teachers are not talking about objects. They are still talking about actions; however, they are not talking about specific actions. They are portraying these actions to be "the way they act" regardless of time. For example, instead of saying, "We modeled the first four jobs," Patricia stated, "We[13] model the first four jobs." That is, she identifies as the kind of teacher who models the roles with her students *on a regular basis*, as opposed to having

[13] Patricia may be using the word "we" here for a number of reasons. David Pimm (yr) has argued that this is sometimes done when speaking about relationships with children, in order to soften the blow of the power differential when an adult is doing something to a child. However, in this case, I believe that Patricia has used the pronoun "we" because she brings three students to the front of the class to help her model the different groupwork roles. Therefore, the "we" refers to herself and three students.

done that at one specific point in time. Joanna could have identified even more strongly had she said, "I am a modeler" (or "we are modelers").

If we conceptualize narratives on a continuum of (as opposed to simply narratives that are reified and those that are not), it is logical that a teacher's narratives would move along that continuum in the process of her identity work. E.g., she might first say about a CI lesson "I modeled", then later speak of her CI math teaching practice saying, "I model," and finally say directly, "I am a modeler."

Integrated Identity

I have argued that persisting in the implementation of CI required the teachers to integrate new ways of identifying as teachers with their prior ways of identifying. *How-I-teach* stories about CI in mathematics are one indicator that some teachers were able to accomplish this integration of identities.

The case in which identity integration is most evident is Joanna. Joanna struggled to integrate her identity as a teacher who gives with a designated identity as a teacher who steps back. However, this designated identity was one that Joanna questioned, even as she worked toward it. One event that helped her to integrate these two identities was seeing a child teach another child about symmetry while Joanna was stepping back. That event was the catalyst for a shift in identifying for Joanna. It enabled her to see that, as a teacher who stepped back, she was also being a teacher who gave a new resource to students—the resource of each others' competencies. At the same time, Joanna continued to modify her use of CI in order to align it with her ways of identifying. As a part of her struggle to integrate her identity as a teacher who gives with her newer identity as a teacher who steps back, she incorporated modeling and longer written instructions into

her use of CI. Eventually, she decided to start the year with some tasks from *Group Solutions Too* (Goodman & Kopp, 2007), a book she received at the CI course, which she felt had tasks that were shorter, easier, and better for teaching students how to work as a group than some other groupworthy tasks she had used. By the end of the Phase II, she was telling *how-I-teach* stories about CI in math class. In one story, she stated, "I start out modeling with tasks from *Group Solutions Too*". In doing so, she is identifying as a teacher who does the beginning of her year this way. She is also performing her newly integrated identity: the teacher-who-gives and the teacher-who-steps-back. Because these types of narratives are indicative of this type of integration of ways of identifying, I call them *integrated identities.*

Expert Identities

In telling *how-I-teach* stories about their use of CI to teach mathematics, the teachers are identifying as having expertise in one or many areas of teaching with CI. This is not to say that an outside observer would necessarily label each teacher as an expert CI teacher. I came to see these particular types of expository narratives as expert identities because of the contexts in which the stories were told. Patricia and Jonathan, the two teachers in the group with the most experience using CI to teach math, told *how-I-teach* stories about it at the beginning of Phase II. They used these stories to identify as the teachers in the group with expertise to share. Joanna and Glynnis told *how-I-teach* stories about using CI in math when the audience was a group of instructors who had not yet taken the CI math PD course. Therefore, in that context, Joanna (and to a lesser extent, Glynnis) identified as having some expertise to share with people who were more novice.

CHAPTER 7: ZOOMING IN: IDENTIFYING AND MATHEMATICS-FOR-TEACHING IN NUMBER LINE NARRATIVES

> Up in Johnstown, at the Institute, we were long puzzled at the case of John Jones. For a long time the clay seemed unfit for any sort of moulding. "Of the Coming of John," (DuBois, 1903/1994).

Overview

Mathematics teacher educators have long been concerned about some elementary teachers' lack of mathematics knowledge and willingness to identify as "not math people." As I interviewed teachers about the mathematics lessons they were teaching using CI, I struggled to get some of them to tell me about the mathematics at stake in the lessons. When I pushed the teachers to talk about mathematics, Patricia, Joanna, and Glynnis would often provide a sentence or two at the most, and would repeat it when I asked them to elaborate. Only Jonathan chose to speak about mathematical content. He would often talk for several minutes about students' understandings of mathematical concepts with little or no prompting.

At first, this bothered me terribly. Would my dissertation only serve to reinforce stereotypes of elementary teachers as not "mathy" enough? Would it reinforce gender stereotypes, as I described Jonathan's enthusiasm for mathematical content and the women's reluctance? And even more disconcerting was my fear that maybe the women in my study had less sophisticated knowledge of mathematics than Jonathan, or that they were harboring some bad beliefs about who and what mathematics was for.

However, looking at the teachers' discourse through the lens of identity gave another plausible explanation for the differences in teachers' talk. My theoretical framework allowed me to look at the teachers' different choices about mathematical

discourse as different ways of identifying. Some teachers identified as having more mathematical competence than others. Whether or not a teacher chose to articulate mathematical concepts explicitly can be seen as a matter of how the teacher positions herself in relationship to the discipline. In choosing not to speak at length about mathematical content, Patricia, Joanna, and Glynnis were choosing to position themselves at a distance from the content (and in proximity to something else). However, whether the teachers identified as competent mathematics teachers did not entirely explain their choice to talk about math content or not. Joanna identified as a "math leader" in her school district, and yet she rarely chose to talk about mathematical content.

At the same time, I was operating under the assumption that all four teachers had some kind of knowledge of mathematics for teaching, because they all seemed like reasonably competent teachers. They often talked about mathematics pedagogies in ways that sounded reasonable, and they had all successfully completed a number of mathematics tasks during the CI course. But if they were not demonstrating this knowledge by talking to me about mathematics, how could I access it? And what was this perplexing relationship between teachers' identifying and their mathematics-for-teaching competencies? Davis and Simmt (2006) argued that much of teachers' knowledge of mathematics-for-teaching is tacit. Therefore, I hypothesized that there might be clues in the *form* of the teachers' talk, to knowledge that was absent from the *content* of the teachers' talk (Hymes, 1972)[14].

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[14] The form/content dichotomy is important here because it attends to the *oral* nature of the storytelling.

In order to examine these questions further, I did a close analysis of the form of excerpts from two stories. Both Glynnis and Jonathan had taught versions of the same lesson on fractions and number lines in their fourth and fifth grade classrooms. Students in both classes were given the task:

> Show where the following numbers fit on the number line. Explain how you know.

Each teacher gave their class a different list of numbers between zero and one, in decimal form, with the task. Jonathan asked the students to draw their number line on a blank piece of poster paper. Glynnis gave each group of students a sentence strip (piece of tagboard about 3 inches by 3 feet) on which was a line segment with the numbers 0 on the far left and 1 on the far right. She instructed students to write the numbers on that.

Because two teachers used the same lesson, I had an opportunity to look at two teachers' identifying and knowledge of mathematics-for-teaching in two stories with the same mathematical content. From each story, I chose an excerpt in which the teachers were attempting to help students understand the metaphor of numbers as points on a line, and both teachers were illustrating the number 1 on the number line. I analyzed the stories for how the teachers were identifying in the stories, as well as how they were performing knowledge of mathematics-for-teaching. I compared who the teachers said they were as math people and math teachers with how they said it. In this chapter, the narratives function to perform knowledge of mathematics-for-teaching that may or may not be explicitly recognized by the storyteller.

In this chapter, I first report on how Glynnis and Jonathan identified themselves in the form of these two excerpts from stories of classroom practice. Second, I report on

how Glynnis and Jonathan perform knowledge of mathematics-for-teaching competencies in the form of their storytelling. To conclude, I discuss the interlinked nature of identifying and mathematics-for-teaching, mathematics-for-teaching as a culturally-laden term, and implications for moving toward inclusive approaches to mathematics teacher education.

The Two Stories

In this chapter, I analyze excerpts from two stories, one told by Glynnis and one told by Jonathan. Glynnis and Jonathan taught the same CI math lesson, in which students were to place numbers on a number line. Glynnis told me the story about how the lesson had failed because her students did not understand number lines. However, she went on to tell me the following story of an lesson that took place two days after the failed lesson:

> Actually one of the women that was so upset, recognizing that from here to here was the one whole. You know, 'cause I think, we were doing it yesterday and they were ordering one and, one, it was all one and, one and, and it was still, hundredths and stuff like that. So I says, "Now, let's write these on the board under each other. Place the decimal here. What do you notice? What do you really notice? You know. What helps you?" So, they notice that, you know. "Ok, if I look at the tenths place, it's real easy. to get it." And so I says, she had went up to plot. She immediately drew a number line. And I was like, "No you're not gonna draw the number line." That was really funny. So she drew the number line, which of course is one of the grade level expectations they're supposed to be able to do. So I was like, "Whoa." So she drew the number line. And she began to do a landmark number. Ok, 'cause she was plotting one and three, one and three tenths lets' just say. I don't remember what it was. So she drew half here [gestured as to the number line]. And so she was beginning to figure out. And then she goes, "Oh. It would have to be over here." I says, "So you're figuring out that between here and here [gestures as to two points on the number line] represents a whole, and the whole has to be divided into what?" And so it kind of was a breakthrough and they were kinda like, "Oh."

Jonathan's told a story about his use of the same CI mathematics task (which Jonathan had originally designed, and Glynnis later adapted). He gave the same number line task as Glynnis; however, he gave it with a couple of other related tasks. One of the other tasks was about measurement. Jonathan reported on all of these tasks:

> Jonathan: The next [group's work] was very interesting because we had not done, measurement. And so this was, this had to be based on what they knew about decimals. And I had meter sticks. And I held up the meter stick. And I said to them, "This is a meter stick. It's one meter. So this is the whole."...The number lines, were the most interesting one. So lets talk about the number lines one...
>
> So the number line, task three, asked them to put the following set of decimals, from largest, on the number line. Yeah. It had a zero, and it had a whole, and it had a half marked on it so. Well, it was very interesting. Because they, what I found was that was very easy for them, because they knew enough about what a tenth was and about what a hundredth was, that they could easily put those in order. No problem. And, you know I, that's good. That's what they need to be able to do. But take a look at my number lines. And, you'll see that, oh. ok.
>
> [Looking at one group's work.] Here's actually a number line. It's actually one of the few that are accurate. And the reason is because none of them, many of them, are not scale number lines. Ok. Like here is a great number line. I mean here is a great table that shows them in order. They're nowhere right where they're, they're. Like, here's point five which really isn't in the middle. I mean there's no, and one hundredth is just as far away from zero as two. You know, in terms of a scale. So they've got no scale. They're not accurately placed. And I didn't realize they were really doing that until the end. Yeah, it was very eye opening for me, because I guess I hadn't done enough with number lines, about what a number line really means. It's not numbers in order it's places on a line. So it was very interesting. I think the kids learned a lot that day when they saw.
>
> [Looking at another group's work, as represented in Figure 8.] This one, what they did. They took a hundred centimeters. They lined them up. And they put, lookit, they labeled one hundredth in the first square.

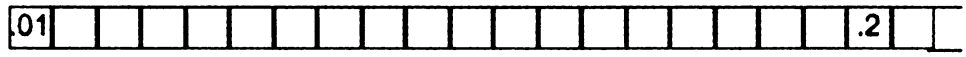

Figure 8. The Students' Number Line Work

> And they went to the twentieth [square] and made it two tenths. And forty-ninth. They didn't put the half there. So actually, what they did is not said where the spot is but they said this square represents, one [hundredth]. So they thought of it more as a fraction, right?

Joy: Well, I think,

Jonathan: One out of a hundred. I'm just now thinking about that. 'Cause I was thinking. Yeah, they put it on the right square, but actually if you put it on a number line, it would be right, there. [Points to the line between two squares.] So I think what they did is they thought of it as one out of a hundred and that's one hundredth of the total. This would equal twenty hundredths or two tenths. 'Cause they're pointing straight at the square. So in a way there's still a misconception about a number line when I look at this.

Identifying

Glynnis

In telling her story, Glynnis identified as a certain kind of mathematics teacher. At first glance, she seemed to hedge a bit, performing some uncertainty about herself by using words such as "I think" (line 4) and at times looking for affirmation from me by saying "you know" (lines 4, 18, and 21), and minimizing the effect of this lesson by saying it was "*kind of* a breakthrough" (line 52) and students "were *kinda* like, oh." (line 53).

Participant and Spectator Roles

Because I am interested in how teachers identify, I was interested in examining the different story-telling roles they perform. In the transcript below, I have categorized Glynnis' story according to when she is performing the role of participant and the role of

spectator. When Glynnis is speaking as a participant, I have used normal text. When she is speaking as a spectator, I use italicized text. I numbered each section (a new section begins when the teacher shifted from participant to spectator role or back). I also underlined the pronouns referring to people in the story, because pronominal shifts are another indicator of changing roles or points-of-view:

1 Actually one of the women that was so upset, recognizing that from here to here was the one whole.

2 *You know, 'cause I think,*

3 We were doing it yesterday and they were ordering one and, one, it was all one and, one and, and it was still, hundreds and stuff like that. So I says, "Now, let's write these on the board under each other. Place the decimal here. What do you notice? What do you really notice?

4 *You know.*

5 What helps you?"

6 *So, they notice that, you know.*

7 "Ok, if I look at the tenths place, it's real easy to get it." And so I says,

8 *she had went up to plot.*

9 She immediately drew a number line. And I was like, "No you're not gonna draw the number line."

10 *That was really funny.*

11 So she drew the number line,

12 *which of course is one of the grade level expectations they're supposed to be able to do.*

13 So I was like, "Whoa." So she drew the number line. And she began to do a landmark number.

14 *Ok, 'cause she was plotting one and three, one and three*

tenths let's just say. I don't remember what it was.

15 So she drew half here [gestured as to the number line]. And so she was beginning to figure out. And then she goes, "Oh. It would have to be over here." I says, "So you're figuring out that between here and here [gestures as to two points on the number line] represents a whole, and the whole has to be divided into what?"

16 *And so it kind of was a breakthrough and they were kinda like, "Oh."*

Glynnis moved back and forth between positioning herself as a participant and as a spectator to the action. However, she constructed herself as a participant more than she constructed herself as a spectator.

Pronomial Shifts. One interesting pronominal shift occurs in section 3 when Glynnis was performing the role of participant. She switched from "we" to "they", saying, "We were doing it yesterday and they were ordering one and..." At the beginning of this statement, she used the pronoun "we", probably to refer to herself and the students together. However, in the same statement she stated that "they" (the students) were doing the mathematics.

Another interesting pronominal shift occurred in section 7. In that section, Glynnis shifted from talking of the students as a group (they, you [plural]) to speaking of a student as "I" when she acted out the role of the student ("If I look at the tenths place..."). She did this although she was referring to more than one student, because she was describing what "they notice" (section 6).

Constructed Dialogue. One way Glynnis identified as a participant is through the use of constructed dialogue. A look at the constructed dialogue in this same excerpt of speech further highlights Glynnis' identification in relation to mathematics teaching. In

order to highlight her use of dialogue in telling this story, I reorganized the same transcript. This time, I indented and italicized the dialogue. Sometimes Glynnis is acting out the role of the students' voice in the dialogue, and sometimes she is acting out the teacher's voice. I distinguished between these two points of view by also underlining the dialogue in which Glynnis is performing the role of herself. This second arrangement of the transcript is included here:

Actually one of the women that was so upset.
Recognizing that from here to here was the one whole.
You know cuz I think we were doing it yesterday
and they were ordering one and, one, it was all one and,
one and, and it was still, hundredths and.stuff like that
so I says
"Now. let's write these on the board. Under each other place the decimal here.
What do you notice. What do you really notice."
You know.
"What helps you."
They notice that. You know.
"Ok. If I look at the tenths place, it's real easy. To get it."
And so, I says.
She had went up to, to plot.
She immediately drew a number line.
And I was like.
"No you're not gonna draw the number line."
That was really funny
so she drew the number line,
which of course is, one of the grade level expectations they're supposed to be able to do.
so I was like
"Whoa."
So she drew the number line.
And she began to, do a landmark number.
Ok cuz she was plotting one and three, one and three tenths lets' just say
I don't remember what it was.
So she, drew half here.
And so she was beginning to figure out.
And then she goes,
"Oh. It would have to be, over here."
I says
"So you're figuring out that between here and here represents. A whole,

and the whole has to be divided into what?"
and so. It kinda was a breakthrough and
they were kinda like.
"Oh."

Arranging the transcript in this way highlights the way in which Glynnis switches back and forth between narrating and role-playing. Looking at just the segments of dialogue, the first thing that is notable is that, Glynnis shifts between dialogue where she is the speaker and dialogue where one or more students is speaking, alternately acting the parts of herself and her students. As she does so, she simultaneously constructs herself, the discipline of mathematics, and her students in particular (though not entirely consistent) ways. In Table 5, I highlight the ways in which Glynnis' constructed dialogue constructs students and herself.

Table 7. Constructed Dialogue in Glynnis' Story

Role	Dialogue	How it constructs students	How Glynnis identifies herself
Glynnis	*now, let's write these on the board. Under each other place the decimal here. What do you notice. What do you really notice. What helps you.*	Capable of understanding mathematical concepts through observation	As an arranger of the environment and an encourager of students
Students	*Ok. If I look at the tenths place, it's real easy. To get it.*	Capable of easily grasping concepts if they are presented correctly	As a teacher who puts students at ease (easy). Also a teacher who understands her students and their thinking.
Glynnis	*No you're not gonna draw the number line.*	As independent, capable of making connections Glynnis doesn't intend them to make at the time	As a teacher who allows students' ideas to take center stage, even when it goes against her original intentions, and even when it makes her uncomfortable.
Glynnis	*whoa*	Surprisingly capable.	Appreciative of students' contributions to the mathematical understanding of the class.
A student	*Oh. It would have to be, over here.*	As a problem-solver	As stepping back and allowing a student to come to her own realization
Glynnis	*so you're figuring out that between here and here represents. A whole, and the whole has to be divided into what*	As people in the process of figuring things out on their own, but still needing a more knowledgeable other to provide formal language	As a provider of more formal language, as a summarizer who articulates students understandings that are not yet formal
Students	*Oh.*	Understanding	

In constructing and performing this back-and-forth dialogue, Glynnis is identifying as a certain kind of teacher—one that encourages dialogue and includes students' voices as well of her own. Had Glynnis only acted out the role of herself in her dialogues, we might conclude that she positions herself in a very different way in relationship with her students. By performing the role of students' voices in this story, Glynnis is positioning herself with them in a certain way. She is identifying as a teacher who empathizes with her students. However, it is also interesting to note that she allots herself more dialogue than she allots to her students. Glynnis is indicating that, in this lesson, her voice is the one that is heard the most.

In the first segment of dialogue, Glynnis says, "Now, let's write these on the board, under each other. Place the decimal here. What do you notice? What do you really notice? What helps you?" In constructing her voice this way, she does several things. She constructs students as able to figure out important mathematical concepts through observation. She constructs mathematical concepts as being available through sensory observation. She constructs her own role in students' learning as being to arrange the numbers in order to make the important concepts more easily observable, and then to challenge and encourage students to do the work of noticing.

In the next line of dialogue, Glynnis plays the part of the student at the board. In doing so, she shifts the point of view of the story to that of the students' experience in the story. She depicts the student as saying, "Ok. If I look at the tenths place it's real easy to get it." She constructs the student as being able to easily grasp how to order numbers if the teacher points out the important place to look. She identifies as a person who can affect students' mathematical success by pointing out important things to them. She

identifies as a teacher who puts students at ease and helps them to achieve confidence in their ability to do assigned tasks.

The next time Glynnis acted out dialogue, she constructed herself as joking with the students, "No. You're not gonna draw the number line." This refers to the lesson a few days previous to this, in which the goal was for students to place numbers on a number line, but then only put them in order and didn't put them in the right place on the number line. Glynnis was constructing this student as having made a connection between these two lessons that not even Glynnis is sure she wanted to have made. She was identifying as a bit hesitant to revisit a topic that previously was fairly traumatic for her and unsuccessful for the students. And yet, she is identifying as a teacher who allows the student to go forward with this line of thinking even though it makes Glynnis a bit uncomfortable. In fact, she uses the word, "Whoa" to qualify her surprise and discomfort here.

Jonathan

Participant and Spectator Roles

When examining Jonathan's story to look at participant and spectator roles, one of the reasons his story seemed so different from Glynnis' became obvious to me. Jonathan spoke from the vantage of a spectator much more than Glynnis did. As I did with the first transcript of Glynnis' story, I have presented Jonathan's story below with the participant role in normal text and the spectator role in italics. I have underlined the pronouns that reference the people in this story, because pronominal shifts may be indicators of the points-of-view of storytellers (Gee, 1989). I numbered the sections in the excerpt (each

section is denoted by a switch from one role to the other). Unlike Glynnis, Jonathan began this excerpt by performing the role of spectator:

1 *The next [group's work] was very interesting because we had not done measurement. And so this had to be based on what they knew about decimals.*

2 And I had meter sticks. And I held up the meter stick. And I said to them, "This is a meter stick. It's one meter. So this is the whole."...The number lines were the most interesting one. Let's talk about the number lines one...

3 *The number line, task three, asked them to put the following set of decimals, from largest, on the number line. Yeah. It had a zero, and it had a whole, and it had a half marked on it. Well, it was very interesting.*

4 Because what I found was that was very easy for them, because they knew enough about what a tenth was and about what a hundredth was, that they could easily put those in order. No problem.

5 *And that's good. That's what they need to be able to do. But take a look at my number lines. And, you'll see that, oh, ok.*

[Looking at one group's work.] Here's actually a number line. It's actually one of the few that are accurate. And the reason is none of them, many of them, are not scale number lines. Ok. Here is a great number line. I mean, here is a great table that shows them in order. They're nowhere right where they're, like, here's point five, which really isn't in the middle. And one hundredth is just as far away from zero as two, you know, in terms of a scale. So they've got no scale. They're not accurately placed.

6 I didn't realize they were really doing that until the end.

7 *It was very eye opening for me, because I guess I hadn't done enough with number lines, about what a number line really means. It's not numbers in order it's places on a line. So it was very interesting. I think the kids learned a lot that day when they saw.*

8 (Looking at another group's work, as represented in Figure 8) This one, what they did, they took a hundred centimeters. They lined them up. And they put, lookit, they labeled one hundredth

in the first square. And they went to the twentieth (square) and made it two tenths. And forty-ninth. They didn't put the half there. So actually, what they did is not said where the spot is but they said this square represents, one (hundredth).

9 *So they thought of it more as a fraction, right? One out of a hundred. I'm just now thinking about that. 'Cause I was thinking. Yeah, they put it on the right square, but actually if you put it on a number line, it would be right, there. (Points to the line between two squares.) So I think what they did is they thought of it as one out of a hundred and that's one hundredth of the total. This would equal twenty hundredths or two tenths. 'Cause they're pointing straight at the square. So in a way there's still a misconception about a number line when I look at this.*

Jonathan spent much more time performing the role of spectator than the role of participant.

Pronomial shifts. The transcript above shows the shifts in pronouns that accompany the shifts between spectator and participant roles. The scarcity of pronouns referring to people is noticeable in a couple of sections in which Jonathan is performing the spectator role—Sections 3 and 5. In those two sections, Jonathan spoke at length about mathematics with little or no discussion of people. In section 5, there are two pronouns with human referents, when Jonathan said, "I mean", and "You know". However, neither of those is referring to a person taking any action. The subjects in the paragraph are mathematical objects—the number line and numbers. This type of talk was not a part of Glynnis' story.

Constructed dialogue. Jonathan constructed very little dialogue in this particular story. The only line of dialogue he constructed was, "This is a meter stick. It's one meter. So this is the whole." This makes sense, given that Jonathan primarily spoke from the vantage point of a spectator, as opposed to that of a participant.

Identifying: Discussion

Glynnis and Jonathan are identifying themselves by the content of their stories. For example, Glynnis did not talk much about mathematics in any of her stories; in fact, this was about as "mathy" a story as Glynnis told. In choosing not to talk about mathematics, Glynnis was identifying as a non-participant in mathematics. (She also did this directly, at another time, saying that she was not a math person.) However, she identified herself as a competent mathematics teacher in a number of ways. She identified herself as a teacher who heard students' voices, when she constructed dialogue for both herself and the students alternately in her story.

In choosing to speak about mathematics, Jonathan identified in the content of his story as well. In talking about mathematics, he identified as a participant in mathematics. Like Glynnis, Jonathan also identified as a teacher who was interested in students. He did not do this by constructing dialogue of students. However, he did this by talking at length about students' work and their understandings of mathematical concepts (for example, in section 9 of the transcript above.

The analysis of the participant and spectator roles in these two stories are telling. At times, Glynnis and Jonathan are both identifying themselves as participants in the classroom action, and at other times they identifying as people who can step outside of the classroom action and interpret it. Glynnis spent more time, in this particular story, performing the role of participant, an insider to the classroom action. Jonathan spent more time, in this particular story, performing the role of spectator, or outside narrator of the classroom action.

Perhaps this is one reason that I originally intuitively felt that Glynnis' and Jonathan's stories were different. In stepping outside of the action and providing relatively lengthy reflection on what was happening and why it was happening, Jonathan was performing a type of knowing that is valued in teacher education—analytic reflection. Jonathan was providing an exposition on the classroom events, in addition to a recount of the events themselves.

It is this type of expository talk that we consider indicative of knowledge in western cultures. When someone a scholar wants to know more about economic policy, for example, she is more likely to consult an encyclopedia than an anthology of stories told by children in poverty. The text in the encyclopedia is privileged as "fact", while the stories may be brushed aside as just people's perceptions.

However, in the section that follows, I argue that both Glynnis and Jonathan, along with identifying themselves as certain kinds of teachers in these stories, have also demonstrated sophisticated understandings of mathematics-for-teaching in their stories. In the next section, I will describe what my micro-discursive, ethnopoetic analysis revealed about their performances of mathematics-for-teaching.

Mathematics-For-Teaching Competencies

The knowledge of mathematics needed for teaching is different in content and form than classical mathematical knowledge. Thus, research on mathematics-for-teaching seeks to describe the understandings of mathematics that teachers need to teach mathematics. However, what counts as necessary mathematics-for-teaching is an issue of debate. Ball, Bass, and Hill (2004) have studied what it is that teachers do in classrooms as a way to learn about mathematics-for-teaching and include teaching practices such as

interpreting students' mathematical work and unpacking the mathematical ideas in a problem. Davis and Simmt (2006) used a complexity-science framework to expand on those notions, studying teachers' mathematics-for-teaching by studying what teachers say in interactions around mathematical content. They said, "We believe that a key (and perhaps *the* key) competence of mathematics teachers is the ability to move among underlying images and metaphors—that is, to *translate* notions from one symbolic system to another." (p. 303).

In making these claims, authors have reported on the *content* of what teachers have said and done in and about discussions of mathematics and mathematics teaching. However, the content of discourse is only part of what is said. *"How* something is said is a part of *what* is said" (Hymes, 1972, p. 59). *How* teachers discursively perform their understandings of mathematics-for-teaching requires further study. In this paper I report on the analysis of teachers' narratives about a particular classroom lesson about fractions on a number line. I focus on teachers' talk to see what can be learned about their mathematics for teaching, focusing on the form of teachers' discourse mathematics and mathematics teaching.

Ethnopoetics and Mathematical Discourse

Interlocuters construct arguments through both the *content* and the *form* of what is spoken (Hymes, 1972). Because mathematics is a discourse, mathematical knowledge and arguments are also constructed through both the *form* and *content* of the communication. Consider the following example from the literature. Staats (2008) highlighted the syntactic parallelism through which a child made a mathematical argument about passing out cuisinaire rods to a group:

1 Yes
2 Cos every fifth one
3 from William
4 is going to be
5 a white,
6 And every fifth one
7 from the next person
8 is going to be
9 a red
10 And every fifth one
11 from the next person
12 is going to be
13 a green
14 eh? (Staats, 2008, p. 26)

She argued that the parallel structure of this speech is the way this child makes his mathematical argument. The child used a template whereby he placed substitutions of words into slots (in this case, the only words substituted are "William" with "the next person" and "white", "red", and "green"). In using this template, he performed performing understanding of the arithmetic pattern and making a generalization. She points out the importance of looking across sentences to discern arguments made implicitly by the form of mathematical discourse. (Staats, 2008).

However, the discourse of mathematics teachers has been primarily studied in terms of content. Little attention has been paid to the form of teachers' mathematical talk. Therefore, the field is missing some important knowledge about how teachers communicate mathematical ideas in their teaching practice.

In the sections that follow, I further analyze excerpts from Jonathan's and Glynnis's stories. I have chosen to analyze in detail only the parts of those stories in which the teachers are trying to help students understand the number one and fractions as points on a number line.

Connecting Mathematically Important Ideas and Moving Between Metaphors

Metaphors for fractions and number lines. Davis and Simmt (2006) argued that the ability to move between metaphors is key to mathematics teaching. Metaphor is a discursive tool. In fact, mathematics may be conceptualized as a discourse. That is, mathematics may be theorized as communication (with oneself or others) about mathematical objects (which are constructed through discourse). Metaphor, or the mapping of language from one domain (for example, physical objects) onto another (such as abstract ideas), is central to creating and understanding mathematical ideas (Sfard, 2008). In the sections that follow, I report on teachers' talk about a lesson on fractions and number lines. Therefore, I will next explain some metaphors that are important to understanding those two concepts.

Lakoff and Nuñez (2000) theorized four grounding metaphors that ground arithmetic to physical objects—the *metaphor of object collection*, the *metaphor of object construction*, the *measuring stick metaphor*, and the *metaphor of motion along a line.* Fractions are often understood using the *metaphor of object construction*, because they are constructed by dividing a whole into parts. In that case, a key metaphor is *numbers as objects*. In the *measuring stick metaphor*, arithmetic is conceptualized as the use of a measuring stick. Numbers are physical segments, with the basic physical segment being one. Longer segments are greater and shorter ones are less. Arithmetic is putting segments together and taking them apart.

Linking metaphors take us beyond the physicality of grounding metaphors to more sophisticated ideas. The metaphor of *numbers as points on a line* is an example. It builds on the measuring stick metaphor and the metaphor of arithmetic as motion along a

path but maps these ideas onto the concept of a line (instead of a physical object). This requires understanding several other metaphors: a number P^1 as point P^1 on a line, zero as a point 0 on the line, one as a point 1 to the right of 0, etc. Sophisticated mathematical understandings and are built by layering metaphor upon metaphor, a process called *conceptual blending*. In contrast, teaching mathematics involves unpacking the layers of metaphor (in effect, unblending) and deftly moving between them to facilitate students' conceptual blending.

Glynnis. Below, I have re-organized a part of the story I described above in which Glynnis is describing an event in which she is talking to a student about placing numbers on a number line. I arranged the following transcript excerpt to highlight parallel ideas. In this case, the subject and action of the sentences are on the left, and the mathematical objects are aligned further right as well as highlighted with bold text:

Stanza 1		
1	actually	
2	one of the women that was so upset.	
3	Recognizing that from	**here to <u>here</u>**
4	was the	**one whole.**
5	You know cuz I think	
6	we were doing it yesterday	
7	and they were ordering	**one**
8	and,	**one,**
9	it was all	**one**
10	and,	**one**
11	and it was still,	
12		**hundredths**
13	and stuff like that	
...		
Stanza 4		
38	So she drew	**the number line.**
39	And she began to do	**a landmark number.**
40	Ok cuz she was plotting	**one and three,**
41		**one and three tenths**
42	lets' just say	
43	I don't remember what	**it**

	was.	
44	So she, drew	**half**
		here.
45	And so she was beginning to figure out.	
46	And then she goes, "Oh.	**It**
	would have to be over	**here."**
Stanza 5		
47	I says, "So	
48	you're figuring out that between	**here and here**
49	represents a	**whole,**
50	and the	**whole**
51	has to be divided into	**what?"**

After reading this excerpt arranged in this format, it seemed to me that a pattern was emerging and that the mathematical objects were generally the objects in each sentence. Next, I analyzed the same transcript to at the basic structure of the sentences Glynnis was using. In the following transcript arrangement, I divided the story into sentences, italicized the subject in the sentence, underlined the verbs, and put the object in bold. I numbered each sentence (which is a different numbering than elsewhere in this chapter, so I have indicated the difference by numbering the sentences in Roman numerals):

i Actually *one of the women* that was so **upset**, recognizing that from here to here was the one whole.

ii You know, 'cause I think, *we* were doing **it** yesterday and *they* were ordering **one and, one, it was all one and, one and, and it was still, hundreds and stuff like that**.

iii So *I* says, "Now, (*you*) let's write **these** on the board under each other.

iv *(You)* Place the **decimal** here.

v **What** do *you* notice?

vi **What** do *you* really notice?

vii You know. *What* helps **you**?"

viii So, *they* notice that, you know. "Ok, if *I* look at **the tenths place**, *it*'s real easy to get it."

ix And so *I* says, *she* had went **up** to plot.

x *She* immediately drew **a number line**.

xi And *I* was like, "No *you*'re not gonna draw the number line."

xii *That* was really **funny**.

xiii So *she* drew **the number line**, which of course is one of the grade level expectations they're supposed to be able to do.

xiv So *I* was like, "Whoa."

xv So *she* drew **the number line**.

xvi And *she* began to do **a landmark number**.

xvii Ok, 'cause *she* was plotting **one and three, one and three tenths** lets' just say.

xviii *I* don't remember what **it** was.

xix So *she* drew **half** here (gestured as to the number line).

xx And so *she* was beginning **to figure out**.

xxi And then *she* goes, "Oh. *It* would have to be **over here**."

xxii *I* says, "So *you*'re **figuring** out that between here and here (gestures as to two points on the number line) represents a whole, and the whole has to be divided into what?"

xxiii And so *it* kind of was a **breakthrough** and *they* were kinda **like**, "Oh."

If you look at these sentences, Glynnis is using a template, which is <someone> <does something> <to something>. This pattern indicates a metaphor of *mathematics as people doing things to* objects. In order to demonstrate the instances in which Glynnis

used this template, I put the sentences above that have action verbs into the table below to demonstrate. I emphasized the mathematical objects in bold:

Table 8. "Someone Doing Something To Something" Template

Sent-ence	**Someone**	**Does Something (the verb)**	**To something (object of the verb)**
ii	We	Were doing	It (the task)
ii	They	Were ordering	**One and hundredths**
iii	I	says	
iii	You	Let	us
ii	(Us)	Write	**These** (numbers)
iv	You	Place	**The decimal**
v	You	Notice	What
vi	You	Notice	What
vii	What	Helps	you
viii	They	notice	
viii	I	Look	**The tenths place**
ix	I	says	
ix	She	had went	up
x	She	Drew	**A number line**
xi	I	Was like (said)	
xi	You	Are not going to draw	**The number line**
xiii	She	Drew	**The number line**
Xiv	I	Was like (said)	Whoa
xv	She	Drew	**A number line**
xvi	She	Began to do	**A landmark number**
xvii	She	Was plotting	**One and three tenths**
xviii	I	Don't remember	**it**
Xix	She	Drew	**half**
xx	She	Was beginning	To figure out
xxi	She	Goes (says)	
Xxii	I	says	
xxii	You	Are figuring out	
xxiii	They	Were like (said)	"Oh"

Below, I have isolated (from the above table) just the phrases that substitute mathematical objects into template in the position of <to something>. In other words, the table below isolates the instances in which Glynnis used the template, <someone> <does something> <to a mathematical object>:

Table 9. "Someone Doing Something to a Mathematical Object" Template

Sent-ence	**Subject**	**Verb**	**Object**
ii	They	Were ordering	**One and hundredths**
ii	(Us)	Write	**These** (numbers)
iv	You	Place	**The decimal**
viii	I (the students)	Look	**The tenths place**
x	She	Drew	**A number line**
xi	You	Are not going to draw	**The number line**
xiii	She	Drew	**The number line**
xv	She	Drew	**A number line**
xvi	She	Began to do	**A landmark number**
xvii	She	Was plotting	**One and three tenths**
xviii	I	Don't remember	**it**
Xix	She	Drew	**half**

Glynnis is constructing mathematics as people doing things to mathematical objects. It is interesting to note the verbs she indicates being done to these objects: order, write, place, look, draw, do, plot, and remember.

Of course, not all of Glynnis's statements fit into the <someone> <doing something> <to something> template. There are a few sentences above in which something or someone is *being* instead of doing. I put the sentences with being verbs into a similar table, Table 10, to explicate:

Table 10. "Someone/Something Is/Was Something" Template

	Someone/something	**Is/was (verb)**	**Something**
i	One of the women	Was	upset
viii	It (doing the problem)	Is	easy
xii	That (what I said)	Was	funny
xxi	**It** (the number)	Would have to be	here
xxiii	It	Was	A breakthrough

It is notable that Glynnis does put a mathematical object into the subject of a sentence (it, the number the student was trying to place on the number line). However, that number does not *do* anything, it simply "would have to be here".

In an attempt to bring some of the above ideas together into one transcript, I have rearranged the first transcript from this section (in which I originally aligned the mathematical objects on the right of the page) so that the verbs acting on the mathematical objects form a second rough column in the center of the text. It is this transcript to which I will refer in the analysis of metaphors that follows it:

Stanza 1			
1	actually		
2	**one** of the women that was so upset.		
3		Recognizing that from	**here to here**
4		was the	**one whole.**
5	You know cuz I think		
6	we were doing it yesterday		
7	and they	were ordering	**one**
8	and,		**one,**
9		it was all	**one**
10	and,		**one**
11	and,	and it was still,	
12			**hundredths**
13	and stuff like that		
...			
Stanza 4			
38	So she	drew	**the number line.**
39	And she began to,	do	**a landmark number.**
40	Ok cuz she was	plotting	**one and three,**
41			**one and three tenths**
42	lets' just say		
43	I don't remember what		**it**
		was.	
44	So she,	drew	**half**
			here.
45	And so she was beginning to figure out.		
46	And then she goes, "oh.		**It**
	would have to be over		**here.**
Stanza 5			
47	I says, "So		

48	you're figuring out that between	**here and here**
49	represents a	**whole,**
50	and the	**whole**
51	has to be divided into	**what.**

Glynnis is bringing different metaphors of number into relationship via parallelism (in the <to something> part of the template) as she tells this story. In Stanzas 1 and 5, notice the alignment of the words "here to here", "one", and "whole". Glynnis is drawing on a metaphor these children understand--the metaphor of *number as object* in order to define the space between zero and one as the *object* on which children should act (divide) to construct fractions. This metaphor is the metaphor by which children first understand fractions. Children come to understand a whole (an object) to be acted upon (divided) to construct fractions (pieces of the whole). Because she is talking about a "whole" (an object) she is drawing on the metaphor of number as object.

However, in using the words "here to here", she makes a *line segment* as an object (the whole), therefore drawing a connection to a second grounding metaphor of arithmetic—the measuring stick metaphor. In this metaphor, arithmetic is seen as measuring with a stick. In order to understand this metaphor of arithmetic, one needs to conceptualize *numbers as physical segments* and *one as the basic physical segment.* Glynnis uses the phrase "here to here" to indicate the parameters of the physical segment. By calling this physical segment (a one-dimensional line segment) a "whole" (a term students have likely used for two-dimensional area models of fractions), Glynnis is facilitating a conceptual blending of the grounding metaphors *number as object* and *number as physical segment.*

In Stanza 4, Glynnis uses parallelism to bring "number line", "landmark number", "one-and-three-tenths", "half", and "here" into relationship. This is a different metaphor

of number, *numbers as points on a line*. This is a more complicated metaphor, and one that Glynnis indicated that students did not understand. She began by using metaphor in Stanza 1 with which the students were already familiar—number as object—and moved to this more difficult metaphor. However, in keeping the words for these mathematical objects within the same place in the same place in the <someone> <does something> <to a mathematical object>, Glynnis is bringing the terms into relationship with each other. She is facilitating the conceptual blending of the metaphors numbers-as-objects, numbers-as-physical-segments, and numbers-as-points-on-a-line through her use of the template.

The way Glynnis maps the metaphors of numbers as objects, physical segments, and points on a line onto each other is in the *form* of her language—in the properties of this talk, such as the structural patterns she used to construct the story. She does not explicitly state the different metaphors on which she is drawing. However, she brings the ideas into relationship through the form of her speech—by using the language of different metaphors but using the cohesion strategy of syntactic parallelism (the use of templates with different words substituted into slots in the template) to help the audience map them onto each other.

In Stanza 5 in lines 47-50, Glynnis returns to a language of numbers as line segments, again by placing parameters on the two ends of a one-dimensional segment. In using the words "here and here" she is indicating that the object to which she is referring is one-dimensional with two ends—it has a length, but that is all that matters in regards to its size.

However, in line 50-51, when she says " the whole has to be divided into what", her language is that of the *arithmetic as construction of objects* metaphor. Children have previously understood fractions as parts of wholes using this metaphor (a fraction is a piece of a whole object). Now Glynnis' language proposes that the children take the metaphor by which they understand fractions, and the new metaphor of numbers as points on a line, and blend those concepts to understand where to place fractions on a number line. By substituting one word for another across lines of speech, using different words that indicate different metaphors for number in the same place in the <someone> <doing something> <to something> template, she intends to help students develop sophisticated metaphorical blends. I highlight Glynnis' shifts between metaphors in the Table 11.

Table 11. Glynnis' Metaphorical Shifts

Stanza 1 1 actually 2 **one** of the women that was so upset. 3 Recognizing that from **here to here** 4 was the **one whole.**			Number as object (whole) Linked to number as physical segments (from here to here)
38 So she	drew	**the number line.**	Numbers as points on a line
39 And she began to,	do	**a landmark number.**	
40 Ok cuz she was	plotting	**one and three,**	
41		**one and three tenths**	
42 lets' just say			
43 I don't remember what	was.	**it**	
44 So she,	drew	**half here.**	
45 And so she was beginning to figure out.			
46 And then she goes, "oh. would have to be over		**It here.**	
47 I says, "So			Numbers as line segments
48 you're figuring out that between		**here and here**	
50 and the		**whole**	Arithmetic as object construction
51 has to be divided into		**what.**	

Notice the order in which Glynnis indexes the different metaphors for number: 1) numbers as objects, 2) numbers as physical segments, 3) numbers as points on a line, 4) numbers as physical segments, and 5) numbers as objects. I am careful to not read too much into this order, because I am only looking at an excerpt of the story. However, I noticed that in this excerpt, Glynnis began with the metaphors in the order in which Lakoff and Nuñez present them in the book (object, segment, points)—the way they argue that these metaphors for number come into being. Then she created reversed the order, creating a symmetrical structure in which she moves from least to most complex and back.

So far in this section, I have discussed what can be learned about Glynnis' mathematics-for-teaching competencies from this story. On a related note, I will close this section with a brief discussion of what can be learned about Glynnis' conceptions of mathematics as a discipline. In Table 12, I revisit the constructed dialogue in Glynnis' story in order to point out clues as to Glynnis' conceptions of mathematics.

Table 12. Constructed Dialogue in Glynnis' Story

Role	Dialogue	How it constructs math	How Glynnis identifies herself	Notes
Glynnis	*Now, let's write these on the board. Under each other place the decimal here. What do you notice. What do you really notice. What helps you.*	Can be known through physical observation	As an arranger of the environment	She is rearranging numbers with students (let's write these on the board under each other) and expecting and asking students to observe.
Students	*Ok. If I look at the tenths place, it's real easy. To get it.*	Observable, easily observed when properly arranged	As a teacher who puts students at ease (easy).	
Glynnis	*No you're not gonna draw the number line.*	Scary	As a teacher who allows students' ideas to take center stage, even when it goes against her original intentions, and even when it makes her uncomfortable.	
Glynnis	*whoa*	The connections are complex and hard to grasp (so when a student does it, it's surprising.)	Appreciative of students' contributions to the mathematical understanding of the class.	

Table 12 (cont'd)				
A student	*Oh. It would have to be, over here.*	As related to place, having a physical position.	As stepping back and allowing a student to come to her own realization	The student comes to know where the number should be, even when Glynnis did not arrange this for her.
Glynnis	*so you're figuring out that between here and here represents. A whole, and the whole has to be divided into what*	As existing in a physical location.	As a provider of more formal language, as a summarizer who articulates students understandings that are not yet formal	There is a case of a mathematical object "here and here" doing something "represents". (Which was overlooked in previous tables because it is included as a noun clause functioning as a direct object—a level of sentence beyond the subject/verb/object analysis above).
Students	*Oh.*			

Glynnis understands mathematics to be an empirical endeavor, similar to other sciences. Students can learn mathematics and construct mathematical ideas through observation. At the same time, she does start to talk to her students about a mathematical object as doing something (it represents). However, almost all of the verbs in this dialogue are attributed to people (what students should do to mathematical objects).

Jonathan. In the following excerpt, Jonathan is telling the story of the number line lesson. Although Jonathan and Glynnis used the same number line task (which I included

earlier in this chapter), Jonathan paired that with a measurement task[15]. A more complete version of this transcript is included near the beginning of this chapter. However, I will summarize it below, often including re-arrangements of the transcript in order to highlight patterns I am noticing.

As with Glynnis' story, it is interesting to note the ways in which Jonathan talks about mathematical objects in the story. In order to highlight this, I have arranged the transcript below so that all of the words for mathematical objects area aligned on the right side and highlighted in bold:

1	I had	**meter sticks.**
2	I held up	**the meter stick.**
3	I said to *th*em.	**"*Th*is**
4	is	**a meter stick.**
4		**It**
5	's	**one meter.**
6	So	**this**
7	is	**the whole. "**
...		
260	I guess	
261	I hadn't done enough with	**number lines.**
262	About what a	**number line**
263	really means.	
264		**It**
265	's not	**numbers in order**
266		**it**
267	's	**places on a line.**
...		
279	Right so actually,	
280	what they did is not said where the	**spot**
281	is	

[15] Jonathan gave the number line task as Glynnis. As a reminder, that task was: "Show where the following set of numbers fit on the number line. Explain how you know." With that task Jonathan had listed the following numbers: "0.86, 0.2, 0.99, 0.49, 0.75, 0.01, 0.6." However, on the same page, in order to facilitate students' connections of decimal numbers across contexts, Jonathan also gave the following task: "A meter stick is made up of 100 centimeters or 10 decimeters. If the meter stick is considered 1 whole, how would you represent the following? 2.17, 0.9, 0.28, 1.11, 0.75."

282	but they said	
283		**this square**
284	represents,	**one (hundredth),**
285	so they thought of it more as	**a fraction.**
286	Right?	
287		**one out of a hundred.**

Compared with the corresponding arrangement of Glynnis' transcript in the previous section, it is notable to note the density of the text on the left hand side of the transcript is different between the teachers. Glynnis has more text in the left side of the transcript than Jonathan does.

I hypothesized that this was a difference in the ways Glynnis and Jonathan were treating mathematical objects, so I also analyzed Jonathan's story to look at the subject, verb, and object in each sentence (the <someone> <does something> <to something> template, described above). Below, I have arranged the transcript of Jonathan's story according to sentences (numbered with roman numerals). I indicated the <someone> (subject) in italics, the <does something> (verb) with underline, and the <to something> (object) in bold text:

i *I* had **meter sticks.**

ii *I* held up **the meter stick.**

iii *I* said to them, "*This* is a **meter stick.**

iv *It*'s **one meter.**

v So *this* is **the whole. "**

...

cclx I guess *I* hadn't done **enough** with number lines, about what a number line really means.

cclxi *It*'s not **numbers in order.**

cclxii *It*'s **places on a line.**

...

cclxxx Right, so actually what *they* did is not said where the spot is.

cclxxxi But *they* said *this square* represents **one (hundredth).**

cclxxxii So *they* thought of **it** more as a fraction, right?

cclxxxiii One out of a hundred.

In order to highlight the way Jonathan used this <someone> <doing something> <to something> template, I display his word substitutions for each of these slots in table 13. In the table, I have indicated the words for mathematical objects in bold text:

Table 13. Jonathan's "Someone Doing Something to Something" Template

Sentence	**<Someone>**	**<Doing Something>**	**<To Something>**
i	I	Had	**Meter sticks**
Ii	I	Held up	**The meter stick**
iii	I	Said	
cclx	I	Hadn't done	enough
cclxxx	They	did	
cclxxxi	They	Said	
cclxxxi	**This square**	Represents	**One (hundredth)**
cclxxxiii	They	Thought	

In Table 14, I have isolated (from the above table) just the phrases that substitute mathematical objects into template in the position of <to something>. In other words, Table 14 isolates the instances in which Jonathan used the template, <someone> <does something> <to a mathematical object>:

Table 14. Jonathan's "Someone Doing Something to a Mathematical Object" Template

Sentence	<Someone>	<Doing Something>	<To Something>
i	I	Had	**Meter sticks**
Ii	I	Held up	**The meter stick**
cclxxxi	**This square**	Represents	**One (hundredth)**

By isolating the subjects, verbs, and objects of these sentences, it became apparent that Jonathan has included a mathematical object in the subject of a <someone> <doing something> <to something> sentence. Therefore, he has indicated a conception of mathematics wherein mathematical objects have agency. They act.[16]

Again, like Glynnis Jonathan also constructed sentences with a different template: <someone/something> <is/was> <something>. I display those sentences in Table 15:

Table 15. Jonathan's "Someone/Something Is/Was Something" Template

Sentence	Someone/something	Is/was	Something
iii	**This**	Is	**A meter stick**
iv	**It** (meter stick)	Is	**One meter**
v	**This** (meter)	Is	**The whole**
cclxi	**It**	Is not	**Numbers in order**
cclxiii	**It**	Is	**Places on a line**

Most of Glynnis' <someone/something> <is/was> <something> sentences were about people; only one had a mathematical object in the subject position of the sentence. However, Jonathan put the mathematical object into the subject of the sentence several times in order to explicate the synonymous nature of two words representing the same mathematical object.

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[16] Glynnis did something similar, which I described in the previous section in Table 10. However, because she did it in a noun clause in a compound sentence, it was not as obvious when looking at verbs in this template.

Like I did with Glynnis' transcript above, I sought to blend some of these ideas and create a re-organized transcript where several of these observations could be seen at once. In the transcript below, I aligned the words for mathematical objects in two columns. When the words appear in the subject of the sentence, that subject is in the middle column. When the words appear in the object of the sentence, they are placed in the far right column. Words for mathematical objects are indicated in bold:

1	I	had		**meter sticks.**
2	I	held up		**the meter stick.**
3	I	said to them.	**"This** is	**a meter stick.**
4			**It's**	**one meter.**
5			So **this** is	**the whole. "**
...				
260	I guess			
261	I hadn't done enough		with	**number lines.**
262	About what a really means.			**number line**
263			**It's** not	**numbers in order**
264			**it's**	**places on a line.**
...				
279	Right so actually,			
280	what they did is not said where the is			**spot**
281	but they said			
282			**this square** represents,	**one (hundredth),**
284	so they thought of it more as			**a fraction.**
285	Right?			
286				**one out of a hundred.**

Jonathan also used parallelism to bring ideas together. In lines 1-5 he is bringing the ideas "meter", "one", and "whole" together. Like Glynnis, he draws on two important metaphors here: numbers as physical segments (lines 1-4) and numbers as objects/arithmetic as object construction (line 5). Again, these are metaphors that had become commonplace in the classroom, and he brings them into relationship by substituting one for another in the template.

In lines 260-264 he adds the concepts, "number line", "places on a line" together. However, when he starts to explicitly describe a number line as "places on a line", he makes the number line (it's) into the subject of the sentence (which I indicate in the above transcript with bold text). He not only brings these ideas into relationship using parallelism, but also explicitly—he is using both the form and the content of his speech to make this argument. It is through parallelism that Jonathan is blending the metaphors of numbers as line segments, arithmetic as object construction, and numbers as points on a line. Making the metaphor, "number lines as places on a line" explicit is done by breaking up the pattern and subjectifying the number line.

In lines 279-286 he uses parallelism to bring the terms, "spot", "square", "one hundredth", "fraction", and "one out of a hundred" together in parallel with previous ideas. The word "square" (an object) draws on the metaphor of number as object, the words "one hundredth", "fraction", and "one out of a hundred" draw on the metaphor of arithmetic as object construction, and the word "spot" (substituted for point) draws on the metaphor of *numbers as points on a line.* In lines 279-281 and 283-286 these ideas are grammatically parallel to one another. However, in line 282 Jonathan subjectifies the mathematical idea (square) in order to make explicit his understanding of the metaphor on which his students are drawing. Throughout most of this excerpt, Jonathan uses parallel syntax as he moves across metaphors in the way he talks. However, at times he switches this pattern with the result that the metaphors become more explicit. I indicate Jonathan's shifts between metaphors in Table 16.

Table 16. Metaphors in Jonathan's Story

Excerpt	Metaphors
1 I had **meter sticks.** 2 I held up **the meter stick.** 3 I said to them. **"This** is **a meter stick.** 4 **It's** **one meter.**	Numbers as physical segments
5 So **this** is **the whole. "**	Numbers as objects (arithmetic as object construction).
260 I guess 261 I hadn't done enough with **number lines.** 262 About what a **number line** really means.	Numbers as points on a line (mathematical objects in object position)
263 **It's** not **numbers in order** 264 **it's** **places on a line.**	Numbers as points on a line (mathematical objects in both subject and object positions, being verbs)
279 Right so actually, 280 what they did is not said where the **spot** is 281 but they said	Numbers as points on a line (mathematical object in object position)
282 **this square** represents **one (hundredth),**	Number as object (mathematical objects in subject and object positions, action verb)
284 so they thought of it more as **a fraction.** 285 Right? 286 **one out of a hundred.**	Number as object (mathematical objects in object position)

Differences between stories. Glynnis and Jonathan are both using similar poetics to bring concepts into relationship as they move across metaphors. Why, then, was I initially under the impression that Glynnis's talk was less mathematically sophisticated than Jonathan's? Was it simply because Jonathan makes metaphors explicit in his story?

There are two main differences I noticed. In the analysis above, there were differences in the ways Jonathan and Glynnis spoke about mathematical objects. Both teachers established a rhythm in their story in mathematical objects were inserted in the <someone/something> <was doing something/was> <to something> template as <to

something> (the object of the sentence). However, Jonathan added complexity by inserting a counter-rhythm into his story when he put the mathematical objects into the subjects of sentences (subjectified them).

In Table 17 I place parts of these transcripts side by to highlight other differences in the form of their talk. Above, I described how Glynnis and Jonathan used parallelism (templates) in similar ways to bring cohesion to their talk when they move from metaphor to metaphor. This is indicated in Table 17 as a box with a solid line. However, in Table 13 it is apparent that the rest of their text is structured very differently. Jonathan's appears to be neat and tidy, only including phrases that line up nicely in parallel (indicated in boxes with dashed lines). In contrast, Glynnis includes an aside (lines 5-13) in which she describes the numbers the students were using in the task. Before and after this aside Glynnis inserts two 3-line stanzas that are grammatically parallel. This brings a sense of cohesion and connection between lines 1-3 and lines 47-49. It seems that the difference is in the economy of syntax, as opposed to the level of sophistication of their mathematics-for-teaching understandings.

Table 17. Comparing Glynnis and Jonathan's Stories

Glynnis		Jonathan		
1 actually		1 I had		meter sticks.
2 one of the women that was so upset		2 I held up		the meter stick.
3 Recognizing that from	here to here	3 I said to them	This is	a meter stick.
4. was the	one whole	4	It 's	one meter.
5 You know cuz I think		5	So this is	the whole
6 we were doing it yesterday				
7 and they were ordering	one			
8 and	one			
9 it was all	one			
10 and,	one			
11 and it was still	hundredths			
12 and stuff like that				
…				
47 I says, "So				
48 you're figuring out that between	here and			
49 represents	a whole			
50 and the	whole			
51 has to be divided into	what			

The difference in the stories' settings could account for some of this variance. Jonathan was telling me about children's work. Glynnis's story was about what she said in interaction with children. Perhaps Glynnis, in the form of her story, is performing knowledge about how her children understand language. Another factor that could account for some of my initial perception is that Jonathan identified himself as "the math guy" and Glynnis as "not a math person". This could have impacted my initial impressions of their mathematics-for-teaching talk. Additionally, a way Jonathan identifies as mathematically competent is by talking about mathematics-for-teaching often and in more formal ways, and Glynnis identifies as not mathematically competent in part by avoiding discussing mathematics-for-teaching.

Does this particular story of Jonathan's perform a more sophisticated understanding of mathematics for teaching than this particular story of Glynnis's? Maybe. After all, Jonathan does, at times, make ideas explicit in a way that Glynnis does not. However, it is also possible that the perception of sophistication upon first read is due to the comparative *elegance* of the way Jonathan brings metaphors together, which is an aesthetic evaluation of the storytelling that parallels one way in which mathematicians evaluate mathematical proofs. For example, Einstein said of mathematical proofs, "We are completely satisfied only if we feel of each intermediate concept that it has to do with the proposition to be proved." (Luchins & Luchins, 1990, p. 38). Perhaps the same culturally-privileged values of the mathematics community have been used to judge teachers' mathematics-for-teaching talk and marginalize some mathematics-for-teaching competencies that facilitate student learning. Is it appropriate to apply the same criteria to

mathematical pedagogical discourse? After all, an elegant mathematical proof leaves out any indication of the messy work that led to it. If teachers and students are engaging in reasoning and proof, it is likely that the majority of their classroom talk will be "ugly" by mathematical standards. Additionally, mathematical proofs are written with others in the same discourse community as the intended audience. Teachers' audiences vary widely in regards to culture, age, children's backgrounds, and the like. Acknowledging that teaching mathematics requires more than classical mathematical knowledge means assuming that the discourse of mathematics-for-teaching will be different than the discourse of classical mathematics. Both Jonathan and Glynnis have tacit knowledge of the ways of speaking that move their particular set of students toward mathematical understandings. Looking at teachers' discourse for their *mathematics-for-teaching competencies* allows us to see teachers' ways with words as competencies that the field has formerly overlooked but that contribute to students' mathematical understandings.

Discussion: Identifying and Mathematics-For-Teaching

Throughout this dissertation, I have argued that elementary teachers' narratives about themselves (their ways of identifying) and their mathematics teaching with CI (stories of implementation) are related, based on a review of relevant literature and lore. In this chapter it is clear that identifying and mathematics-for-teaching are indeed interlinked. In comparing what teachers said about who they are as math people with how they said it, I gained insights into identifying and mathematics-for-teaching. In the section that follows, I discuss ways in which identifying and performing knowledge of mathematics for teaching are interlinked, knowledge of mathematics-for-teaching as a

culturally-laden concept, and the implications for inclusive approaches to mathematics teacher education practice and research.

How Identifying and Mathematics-For-Teaching are Interlinked

At the very least, identity and mathematics-for-teaching are performed simultaneously in these two teachers' stories. In the first part of this chapter, I demonstrated some of the ways in which the teachers were identifying themselves as mathematically competent (or not). In the second part, I theorized about what might be possible to learn about the teachers' mathematics-for-teaching. Therefore, I have demonstrated the ways in which both of these things were done in very sophisticated ways simultaneously in the telling of the stories. But do they simply bubble up simultaneously in these stories? Or are impacting each other? In the sections that follow, I will make two observations about how identifying and mathematics-for-teaching might be seen as related—one in Glynnis' case, and one in Jonathan's.

Glynnis: Uncertainty in Her Mathematical Knowledge and the Tentative Nature of Knowledge

As I described in the results section, a first look at Glynnis' story evidenced verbal hedges, such as "kind of" and "let's just say", which may be perceived by the audience as a lack of confidence (whether or not Glynnis would perceive them as such). However, Glynnis had directly identified in an earlier interview as "not a math person" and had hesitated to talk about mathematical content or her students' understanding of mathematics.

In the analysis of the dialogue in her story (Table 12) I demonstrated that one way she identified her role as a teacher was as an arranger of the environment. She

constructed students as capable observers, if only the objects to be observed were carefully arranged.

The analysis of Glynnis' mathematics-for-teaching opened the possibility that Glynnis views mathematics as an empirical science that is socially constructed[17]. If this is the case, then it makes sense for Glynnis to view her own knowledge of mathematics with the same tentative nature with which a social constructivist views the entire body of mathematics. As well, a view of mathematics as empirically and socially constructed could lead Glynnis to believe that students need to be actively involved in discovering mathematical ideas, and that her role is to let students' voices be heard. The fear that "untruths" would be discovered would not necessarily be of concern, because mathematical ideas are open to revision at any time in the process.

Jonathan: Being Verbs and Certainty

In Chapter 2 I presented a definition of direct identifying statements (what Sfard calls identifying narratives (Sfard 2006a, 2007; Sfard & Prusak, 2005) as statements about oneself that are reified, endorsed, and significant. "I am" statements are particularly powerful and decisive direct identifying statements. For example, "I am good at mathematics" and "I am a mathematics teacher" are more powerful statements of identity than "I did well in mathematics" and "I teach mathematics" (although no statement is identity-free, of course). I also presented Sfard & Prusak's (2005) notion of First-,

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[17] In an earlier interview, Glynnis expressed a view that mathematics is changing, which could be further evidence of a social constructivist philosophy of mathematics. Further analysis into whether there is evidence of this philosophy throughout all of Glynnis' interviews may be interesting in the future. However, as this chapter is intended to be a theoretical piece that opens up the possibility of a link between a teacher's ontology and her identifying (as opposed to an empirical piece proving that this is the case).

Second-, and Third- person identifying statements. That is, first-person identifying statements are statements made about oneself to oneself, second-person identifying statements are made by someone else to the person being identified, and third-person identifying statements are statements made by someone to someone else about a third person.

Remember that earlier in this chapter I noted Jonathan's use of being verbs in which mathematical objects were the direct object. In Table 15 I presented five such sentences, in which Jonathan made statements such as, "This (a meter) is the whole." Such a statement has something in common with the most powerful forms of direct identifying statements, the "I am" statements. As such, these statements of Jonathans could be seen as third-person identifying statements in which Jonathan is talking about mathematical objects (directly identifying them) to his students. Additionally, Jonathan had afforded mathematical objects agency, a trait usually assigned to humans.

At the same time, Jonathan is performing his conception of ontology of mathematical objects, and at the same time, identifying himself as a mathematically competent person. He is identifying as a person who knows mathematical objects well enough to identify them to someone else, similarly to one person describing another person to a third person (third-person identifying).

Identifying and Perceptions of Competence

I had originally identified Jonathan as "mathier" than Glynnis, which is a perception I made because of how Jonathan and Glynnis identify differently. They both performed different aspects of their conceptions of mathematics as a discipline—while both had conceptions of mathematics that could be described as realist, Jonathan

positioned himself as close to the mathematical objects (identified with them) and Glynnis positioned herself more distant from them (as objects to be discovered and examined, not known as one knows another person).

Both of these ontological stances are fairly sophisticated and somewhat different than one might expect. And both would affect both the ways teachers identify and perform their knowledge of mathematics-for-teaching. Therefore, they may not be perceived similarly by an outsider. Glynnis might have been performing a sophisticated conception of the tentative nature of mathematical knowledge, but uncertainty may be perceived by others as incompetence. On the other hand, Jonathan identified as closely knowing mathematical objects in making third-person identifying statements about them. Such statements are likely to be perceived as confidence, and therefore, competence.

Knowledge of Mathematics-For-Teaching as a Culturally-Laden Term

Discourses are situated within cultures, which have different discursive routines and value different forms of communicating. The culture of academic mathematics, for example, values elegance in mathematical proofs. However, the culture of classrooms is a very different culture. It is therefore inappropriate to apply the same criteria to mathematical pedagogical discourse. An elegant mathematical proof leaves out any indication of the messy work that led to it. If teachers and students are engaging in reasoning and proof, it is likely that the majority of their classroom talk will be ugly by mathematical standards.

Additionally, mathematical proofs are written with others in the same discourse community as the intended audience. However, teachers' audiences vary widely in regards to culture, age, children's backgrounds, and the like. Acknowledging that

teaching mathematics requires more than classical mathematical knowledge means assuming that the discourse of mathematics-for-teaching will be different than the discourse of classical mathematics, in part because the context is different. Not only that, teachers' discourse of mathematics-for-teaching is likely to vary between contexts with different discursive routines. Glynnis' students and Jonathan's students are in different contexts and likely have different discursive norms. Therefore, the differences in their performance of mathematics-for-teaching might indicate that each has deep knowledge about their students, their context, and the discursive routines therein.

Perhaps this is not so different than the way "standard English" is privileged over "colloquial dialects". It is a prevailing myth that "colloquial dialects" are simplified or lazy versions of "Standard" English. However, studies have shown that they have complex rule systems.

Implications For Inclusive Approaches to Mathematics Teacher Education Practice and Research

A goal in the CI mathematics course was broadening teachers' conceptions of mathematical competence so that they could see the competencies that students bring to the mathematics classroom that help them to solve mathematical problems but have not traditionally been privileged in mathematics classrooms. Teachers are taught to begin to see students' competencies such as communication through visual rhetoric (color-coding, use of white space, etc.), verbal skills, geometric imagination, and others as mathematical competencies. Teachers also think about designing tasks that teach important mathematical concepts while drawing on these competencies. The purpose is to create

tasks that engage a larger number of students in mathematics to make participation and learning more equitable within a particular classroom.

In the same way, mathematics teacher educators should carefully examine the competencies teachers bring to the classroom in order to understand the competencies teachers bring to the classroom that may not yet have been privileged in learning to teach mathematics. It is for this reason that I chose to talk about teachers' *mathematics-for-teaching competencies* instead of simply mathematics-for-teaching. In doing this we open possibilities for designing professional development and teacher education tasks which validate and extend those competencies.

In designing and facilitating professional development and teacher education courses, teacher educators have a choice to make about how teachers' are viewed upon entering the courses. Either teachers are viewed as lacking knowledge and skills—empty buckets to be filled or ignorant cave dwellers like those in Plato's "Allegory of the Cave," or they are viewed as bringing something worthwhile to those courses which can then be leveraged to help them learn new practices. I argue that this second attitude toward teachers needs to be explicitly adopted in order to make PD and teacher education courses more inclusive to a wide variety of teachers.

CHAPTER 8: DISCUSSION AND CONCLUSIONS

Throughout this dissertation, I have argued that teacher learning may follow a similar story plot as other stories of learning, in that it results in new ways of identifying and being able to participate in families and communities (Cartlidge & Gilbert, 1983; DuBois, 1903/1994; Reed & Johnson, 2000). I have also argued that teacher learning needs to be viewed as an end unto itself, for the enrichment of teachers' lives, instead of only as a means to an end, for changes in practice and improved test scores for students (Featherstone, 2005).

I first made this argument in Chapter 1 by explicating the parallels between the stories "Of the Coming of John" (DuBois, 1903/1994), *Educating Rita* (Cartlidge & Gilbert, 1983), and Plato's "Allegory of the Cave" (Reed & Johnson, 2000), and claiming that the story I would tell in the dissertation would be parallel to those stories. That is to say that teacher learning, just as the learning portrayed in those accounts, is challenging and has unintended consequences.

In Chapter 2, I retraced the history of the problem for study, claiming that theories on the stability of teaching practice were insufficient to explain why some teachers are able to make and sustain changes in their teaching practice. I constructed a framework for this study, drawing on socio-cultural theories of narrative and identity. I stated my research questions as being about the relationship between teachers' ways of identifying and their implementation of new practices, how the difficulties inherent in changing teaching practice and teachers' abilities to sustain implementation of new practices may be considered identity work, and the dynamic nature of teachers' ways of identifying. I argued that a narrative study is an effective method for studying identity and teacher

learning in that it avoids treating teachers only as a means to the end of student achievement (Featherstone, 2005) by illuminating teachers' voices.

In Chapter 3, I described the design of my dissertation study and explicated methodological decisions made during the course of the study. In particular, I argued for the affordances of a study of different kinds of narratives (life-stories, recounts of events, and direct identifying statements) in different contexts (individually, in groups of CI teachers, and in groups where teachers had not yet taken the CI course) in order to answer my research questions regarding teachers' ways of identifying and implementation of new practices and to speak to my larger problem for study, which is that we do not yet understand all of what must occur for a teacher to change her practice in order to add teaching practices and do so in the ways that reformers recommend.

Chapters 4, 5, 6, and 7 are the findings chapters in this study. In Chapter 4, I described the ways that teachers' life stories functioned to propose reasons for choosing to implement (or not implement) CI. I described a number of different possible connections between teachers' life stories and choices of implementation (e.g. implementing CI to revise a life story).

In Chapter 5, I described the ways that teachers' identifying narratives became obstacles to be overcome as they implemented CI, and how their ways of identifying ultimately sustained their persistence. I argued that speaking about the necessary shifts in ways of identifying provides a way for researchers to avoid speaking of teachers in deficit terms, and affords an opportunity to learn about teachers in the ways we argue that teachers should learn about their students. In Chapter 6, I described teachers' generalized

stories of practice (*how-I-teach* stories), and theorized about the integration of prior and new ways of identifying in order for teachers to construct expert identities.

In Chapter 7, I zoomed in to a close-up, ethnopoetic analysis of two teachers' stories about their implementation of a similar lesson. In this chapter, I theorized that identifying and mathematics-for-teaching were closely interlinked, and sometimes the same practice. I also argued that mathematics-for-teaching should be studied using narrative methodology, in order to attend to teachers' unarticulated knowledge of mathematics-for-teaching.

In the present chapter, I look across the discussion sections of all four findings chapters in order to bring them together and answer my research questions. I will first discuss my research questions in order, drawing from the four findings chapters to answer them. Then I will explicate the limitations and implications of my study on teacher professional development practice and research. I will conclude the dissertation with a discussion of my plans to further this line of research.

Contributions of the Dissertation

As a reminder, the research questions that have guided this dissertation study are as follows:

1. How do teachers' ways of identifying and their stories of implementation of a new mathematics pedagogy interrelate?
2. How do teachers' ways of identifying become obstacles (or not) to teachers' attempts to change their teaching practice? How do they make sense of the obstacles and overcome them?
3. How do teachers' ways of identifying change (or remain the same) as teachers implement CI to teach mathematics?

The next three sections each address one of these three research questions.

The Relationship Between Identifying and Implementation

My first research question asked how teachers' ways of identifying and their stories of implementation were interrelated. Studies had previously drawn a one-way connecting arrow between teachers' ways of identifying (in life stories) and their implementation of a specific reform curriculum (Drake, 2006; Drake, Spillane, & Hufferd-Ackles, 2001). These studies connected teachers' life stories and their implementation of the curriculum based on classroom observations. I chose not to observe in classrooms, but rather to collect teachers' narratives of the classroom lessons in question. This was a purposeful move, because in doing so, I was able to learn about more than the activity that I observed in the moment of practice. I was able to learn about how the teachers understood the relationships between their self-perceptions and improvisations of practice moment-by-moment. How teachers were making decisions about implementation, how they were thinking about their implementation after the lessons, and how they were making sense of Complex Instruction were most important to me. Had I been present in the classroom when the lessons were taught, teachers would

have made assumptions about what I had seen and thus already knew about the lessons, and may have had less reason to communicate their impressions to me.

Identifying Narratives and Implementing or Not Implementing CI

Another advantage to a narrative study was that I was able to look for connections between identifying and teaching practice that have previously been unexamined and look for explanations for those connections. As I reported in Chapter 4, the teachers identifying narratives functioned to propose reasons for choosing to implement (or not implement) Complex Instruction (CI). This is unsurprising, given the results of Drake's life story studies (Drake, 2006; Drake, Spillane, & Hufferd-Ackles, 2001). Those studies spoke to the question of differences in implementation between teachers with different life stories, but not about the *decision* to implement the reform or not, or the reasons for the connections (or apparent disconnections) between life stories and practice.

This study proposes reasons for some of the connections between identifying and choosing to implement CI. In the discussion section of Chapter 4, I propose that the choice to implement CI may sometimes be due to a match between the principles of CI and the ways the teachers' identify. For example, the main purposes of CI are to promote equitable and rigorous mathematics instruction in classrooms, and those were salient aspects of how Jonathan constructed both his designated and current identities; therefore Jonathan's decision to implement CI was unsurprising. However, it seems that other teachers choose implementation because it allows them an opportunity to revise their life stories as they provide different experiences for their students (and for themselves as teachers) than they experienced as children. And in the case of teachers with failure (foreclosed) identities, perhaps the way of identifying as a mathematics teacher and

learner is too scary to revisit, thereby making the consideration of a new pedagogy too frightening.

Before going on, however, I will comment on the label "failure (foreclosed)". I have chosen to use this label in order to build upon and discuss work that has already made inroads into the relationship between identifying and implementation. As I do so, however, I am struck by the way that this label implies that failure is a static way of identifying, and seems to close the door on any hope of a turning point in the future. This label was likely intentional on the part of previous researchers, who likely noted that stories of previous failures are often difficult to revisit and overcome. However, the very existence of turning-point stories implies that stories of failure do not necessarily preclude the implementation of new mathematics teaching pedagogies. Additionally, although Gina did not experience a turning point in the CI course, she did say that it enabled her to envision herself participating another mathematics PD event in the future—something that she would not have considered before the course.

It is important to stress again that I do not intend to imply that only teachers who bring certain ways of identifying with them to PD courses have the possibility of success. Because identifying is dynamic—both within individual lessons and across longer time spans—any teacher should be seen as capable of success in the CI math PD course. What is important is that PD facilitators and designers learn about teachers' ways of identifying in order to help facilitate the types of connections between identifying and new practices that will allow teachers' to see the new practices as possibilities. I argue that the CI math PD course in particular allowed a variety of different teachers to see it as a part of their designated identities—part of the kinds of teachers they already wanted to become.

Perhaps the CI math PD course is different than other PD courses in this way. After all, the use of CI to teach mathematics has been found to allow more students' identities to be expressed in mathematics classes (Jilk, 2007). Perhaps the same is true of the CI math PD course.

Identifying Narratives and Teachers' Understandings and Implementation of Teaching Practices

It appears that teachers' ways of identifying and stories of implementation of CI were connected, if sometimes in unexpected ways. For example, Jonathan saw himself as rigorous and inclusive, so it was unsurprising that he would choose to implement and sustain implementation of CI, because rigor and inclusion are its two important principles. However, Joanna sometimes identified as person who joined projects, Glynnis often identified as resistant, Patricia identified as a behaviorist—and all three saw CI as a pedagogy that could help them to become more like their designated identities. Therefore, the links between a recommended pedagogy and teachers' ways of identifying may not always be as expected. Therefore, just as teachers are encouraged to learn about their students in elementary classrooms, it is critical that PD facilitators and designers spend significant time learning about the kinds of teachers that participants in our courses want to become.

Even though it seems that the teachers who chose to implement CI had originally perceived it as helping them to become more of the kinds of teachers they wanted to become, for three of the four teachers, something troubled this during the time I was collecting data. Sometimes teachers perceived themselves to be acting in ways contrary to their identifying narratives. For example, at a point in time, Joanna perceived CI as not

allowing her to be as giving as she would have liked. Therefore, she changed the way she was implementing CI in order to ease this discomfort for her. If I had done pre-course and post-course observations of Joanna to determine what she had learned from the PD course, and had only come during the time Joanna was giving her lengthy lists of written directions, I might have concluded that the CI course actually hurt her teaching practice in some way and assumed that it was because of a lack of knowledge or some bad beliefs. However, collecting Joanna's stories during that time, as well as over the course of several months as she went through the cycle of planning, implementing, and reflecting on three different CI mathematics lessons, I was able to see that each implementation of CI was changing her perceptions of the pedagogy itself. That is, Joanna was learning something from implementing CI math lessons, because each implementation was changing her discourse about her teaching[18].

A final point I would like to make about teachers' ways of identifying and their stories of implementations of new practices (and the point I think is most important) is this: Sometimes what has previously been spoken of as teachers' misunderstandings of or inabilities to implement new practices may sometimes be more aptly described as a perceived mismatch between teachers' current ways of identifying and the pedagogy. When teachers' choose not to implement a new practice, or when their implementation does not look or sound exactly like expected, further investigation is needed before

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[18] I have argued, with the theorists cited in my literature review in Chapter 2, that identity and learning are closely intertwined. Because I am studying identity, which is a part of learning, I feel confident in also claiming that the teachers are learning from their implementation of CI. In doing so, I am defining learning as a change in discourse (Sfard, 2008). How and what these teachers learned is not the focus of this particular study. However, it is certainly a topic of interest to me that I hope to pursue further in this data set, as explained in the Implications section at the end of this chapter.

assuming that something is lacking. Listening to teachers' narratives is an important start to understanding all of what goes into teachers' decisions about and implementations of recommendations made in PD events.

Identifying and Mathematics-For-Teaching Impact Each Other and Are Often the Same Thing

In Chapter 7, I argued that teachers not only identified and performed knowledge of mathematics for teaching simultaneously, but that these were often the same practice. For example, one way to read how Glynnis was identifying was to see her as less confident in her knowledge of mathematics for teaching than Jonathan. Based on my analysis, and on other comments made by Glynnis about the nature of mathematics as a discipline, it is likely that Glynnis viewed the discipline of mathematics as less certain as well. She had stated that mathematics changes and that it was constructed by people. Perhaps, then, it is unsurprising that Glynnis regarded her own knowledge of mathematics with skepticism—not because she was uneasy about her own capabilities (or perhaps, not only because of that), but because she viewed mathematical knowledge itself as tentative.

If I had done a survey study of Glynnis' self-efficacy or beliefs about herself as a mathematics teacher, I would have likely missed this possibility. Perhaps I would have concluded that Glynnis was lacking self-efficacy or harbored some bad beliefs about herself as a teacher. A narrative study allowed me to tease out some of the parallels between how Glynnis was talking about herself and about mathematics as a discipline. It allowed me wonder if perhaps, in a way, Glynnis was identifying *with* mathematics, not against it, in regarding her knowledge as tentative.

Teaching as Identifying

I have argued repeatedly that participation and narratives of participation are ways that people identify. I have argued further that narratives are even more telling than an observation of a teacher's implementation (participation) in regards to identifying, because it is through narratives that we learn about the ways teachers are making sense of and understanding their implementation. After all, there are times when all of us act in ways in which we did not intend (and with which we would not like to identify). In producing narratives of participation, the teachers were helping me to understand the ways they were reifying experience into narratives of their practice. One way to say this is to say that the teachers were *teaching me* about their learning and identifying. Perhaps all narratives are a pedagogical practice in some sense.

However, another way to view this is to say that the narratives teachers were constructing were a part of their teaching practice. Teaching practice may be said to include more than the improvisation of practice in the presence of children—planning for lessons and reflecting on them may also be considered practice. In that sense, teachers identifying narratives were a part of their larger teaching practice. As they told narratives, they constructed themselves as teachers and constructed their teaching practice.

Obstacles and Persistence

My second research question asked how teachers' ways of identifying created obstacles to their attempts to implement new practices, and how the teachers overcame such obstacles. I argued that, although researchers and theorists have noticed that teaching is difficult to change (e.g. Lortie, 1975), the reasons for the stability of teaching practice are incomplete, because they have not taken teachers' ways of identifying into

account. Analyzing teachers' narratives has illuminated some of what makes teaching with new pedagogies so difficult.

As explained in Chapter 3 (Methodology), all of the teachers in my study had at least eight years of teaching experience when the study began. Therefore, it is unlikely that the difficulties associated with implementing new practices were simply about the difficulties inherent in crafting a new teaching practice for the first time. These teachers were accomplished teachers, and implementing new practices was still not an easy task. In this study, I set out to understand why.

In analyzing teachers' life stories, stories of teaching, and stories of teaching mathematics with CI, I looked for parallels and contrasts between how teachers were identifying as mathematics teachers in general and how they were identifying as CI mathematics teachers in particular. I discovered that when the teachers' ways of identifying clashed with the ways they saw CI as requiring them to be, discomfort ensued. However, it seems that the teachers did not always locate the source of this comfort within their own teaching. Teachers went through times when they were concerned that the difficulties were because of their own teaching, but also thought they might be because of their students, because of CI, or because of the context in which they were teaching. I describe this obstacle as being a clash or inconsistency between the teacher's previous ways of identifying and their perceptions of the type of teacher they would need to be as a CI teacher.

Assigning a Location to the Problem

Before continuing to discuss the implication of the gap between these two ways of identifying, I will comment on the idea that teachers tended to interpret this discomfort as

a problem located with their own performed knowledge, their students, their context, or CI. I argue here that it is unsurprising that teachers would assume that the discomfort they were feeling was due to a problem located in one of these four locations, because that is the rhetoric that they hear regularly. Consider the opening excerpt from NCTM's *Principles and Standards for School Mathematics* (2000) in which I have emphasized the factors that are said to make the classroom what it is:

> Imagine a classroom, a school, or a school district where all students have access to high-quality, engaging mathematics instruction. There are ambitious expectations for all, with accommodation for those who need it. Knowledgeable teachers have adequate resources to support their work and are continually growing as professionals. The curriculum is mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding. Technology is an essential component of the environment. Students confidently engage in complex mathematical tasks chosen carefully by teachers. They draw on knowledge from a wide variety of mathematical topics, sometimes approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress. Teachers help students make, refine, and explore conjectures on the basis of evidence and use a variety of reasoning and proof techniques to confirm or disprove those conjectures. Students are flexible and resourceful problem solvers. Alone or in groups and with access to technology, they work productively and reflectively, with the skilled guidance of their teachers. Orally and in writing, students communicate their ideas and results effectively. They value mathematics and engage actively in learning it.

Notice that the teachers, students, curriculum, and context are all constructed as extremely desirable, and are all constructed as necessary pieces to this puzzle. The teachers are "knowledgeable" and "skilled", the students are confident, "flexible and resourceful", "work productively and reflectively", and "value mathematics." The curriculum is "mathematically rich". The context is ideal. There are "adequate resources" including technology and opportunities for professional growth.

The document continues, saying the following about what it will be required for high-quality mathematics teaching:

> The vision for mathematics education described in Principles and Standards for School Mathematics is highly ambitious. Achieving it requires solid mathematics curricula, competent and knowledgeable teachers who can integrate instruction with assessment, education policies that enhance and support learning, classrooms with ready access to technology, and a commitment to both equity and excellence.

Based on this statement, one might logically conclude that if classrooms look different than those described at the beginning of the NCTM document, it might be because the teachers, the policies, the classroom resources, and/or a lack of commitment.

An explication of the role teachers' integration of ways of identifying renders more complex this view of what it takes to achieve new visions of mathematics teaching. There are implications to the statement that "teachers who can..." are required. One implication is that it sounds deceptively static, as if there are simply "teachers who can" and "teachers who cannot" teach in the way the standards suggest and those are fixed. The result is a simple categorization of the "cans" and the "can nots", and possibly the removal of the latter. However, as evidenced in this study, teachers' mathematics teaching identities and their understandings and implementations of reforms (such as CI) are both moving targets. Again, if I had observed Joanna only during the time in which she was providing students with lengthy written directions, for example, I might have too quickly assumed that she was a "can not". A narrative study allowed me to understand a case in which this made sense in Joanna's practice, and returning several times allowed me to see how implementing CI in this way impacted Joanna's implementation of CI after that. If I had relied only on Kelly's report that she had chosen not to implement CI, I might have too quickly assumed that she was a "can not" who was not willing or able to make

changes in her practice. Instead, by analyzing her life story, I was able to understand that her perceptions of herself and mathematics did have an impact on her teaching. Based on the results of this study, I anticipate that Kelly will continue to learn about these things as she continues to teach mathematics in more discussion-oriented ways.

Overcoming the Obstacle and Sustaining Implementation

The teachers all seemed to settle these differences in different ways. For example, Joanna changed her perception of her students such that she was able to see them as resources for each other. That led to a change in her perception of her role when she realized that, in stepping back, she could give students those resources. This allowed her to perceive CI as a pedagogy that aligned more closely with her ways of identifying. Jonathan began to see himself and his colleagues as less collaborative. This did not seem too troubling to Jonathan, who perceived that his colleagues still saw him as competent, and so he did not alter his perceptions of or his implementation of CI as a result.

While the three teachers whom I observed to be experiencing differences between their previous and new ways of identifying all found different ways of integrating their ways of identifying and overcoming this obstacle, they all had one thing in common: they all sustained their implementation of CI because they were able to find a way in which being a CI teacher allowed them an opportunity to be themselves. It was the case in all four teachers that, in order to persist in sustaining implementation of CI, all four had to come to a place where they perceived being a CI teacher as being consistent with their self-perceptions. They all had to see being a CI teacher as being a way of identifying that they could integrate with the other ways they wanted to identify as a teacher.

Understanding both the obstacles that necessary identity work poses and the ways that teachers' ways of identifying motivate their persistence is an important step in treating teachers as more than a means to the end of student achievement (Featherstone, 2005).

The Dynamic Nature of Identifying and Implementation

In Chapter 2, I noted that the previous link between identifying and implementation could be viewed as a one-way arrow where teachers' identities impacted their implementation (Drake, 2006; Drake, Spillane, & Hufferd-Ackles, 2001). Then, I hypothesized that this arrow would go both ways, so that not only would identifying impact implementation, but that as teachers continued to implement a new teaching practice, their ways of identifying would change. I conceptualized this relationship like Figure 9.

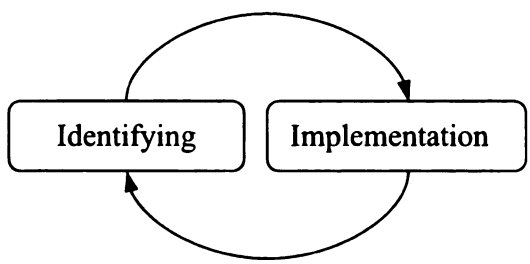

Figure 9. Original Concept of Identifying and Implementation

Over time, many of the teachers began to tell generalized narratives of their CI mathematics teaching. I refer to these generalized narratives as *how-I-teach* stories, because the teachers often began them by saying something like, "When I do CI...". The result was that the narratives functioned to claim some certain ways of being CI teachers as the teachers' own. In a sense, the idea that they were "CI teachers" was assumed, and they had moved beyond into identifying as a certain kind of CI teacher through these

narratives. I have argued that these generalized narratives may be seen as a link between specific stories of teaching mathematics with CI and reifications of experience such as directly identifying as "a successful CI teacher". This is one way I saw implementation impacting teachers' ways of identifying over several months' time.

However, I after completing this study it is obvious that Figure 10 implies a view of identifying that is too static. Teachers identified in many different ways, sometimes within the same story of the same lesson. On the other hand, teachers sometimes identified in ways that were more stable from story to story. While my study has not yet untangled all of the relationships involved in identifying and implementation from moment-to-moment, it is likely that, at the very least, a dimension of time needs to be added to this conception of identifying and implementation, as shown in Figure 10.

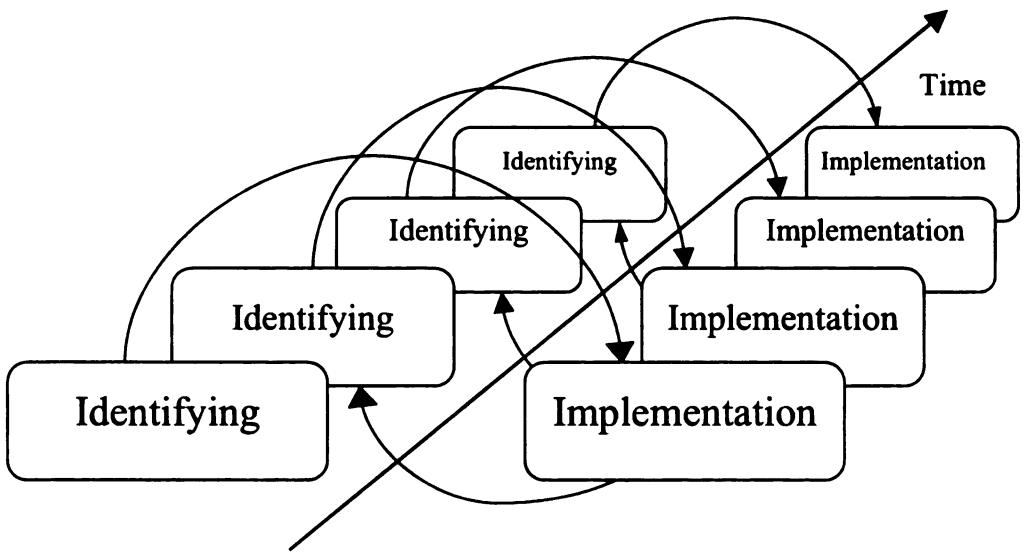

Figure 10. The Relationship Between Identifying and Implementation of CI

The element of time is important because how teachers' identify is, at times, a moving target. An example is Kelly. Kelly reportedly changed how she identified as a math person in the context of the CI workshop, and reported that this change influenced the

changes in her practice (even though she did not report implementing CI in all of the ways discussed in the course).

However, Figure 10 is still an imperfect representation of the relationship between implementation and CI, because it appears that identifying and implementation are changing constantly and at the same rate, which would be beyond the scope of my study to determine. Additionally, as I stated earlier in this chapter, sometimes identifying and implementation appear to be almost the same thing, and this diagram portrays them too separately. A third limitation of the diagram is that it portrays a constant motion forward through time, when perhaps it is likely that people may go back and forth in reverting to previous ways of identifying and newer ways of identifying in the process of integrating older and newer ways of identifying.

Limitations of the Dissertation

In this section, I will describe how the ways I limited the study participants, the study context, the time period of the study, and the analysis of narratives, and the effects that these limits have on the conclusions drawn from this study.

I limited the participants in this study to those who could be described as experienced teachers. I did this purposefully, because I did not want the evidence of identity shifts inherent in becoming a teacher to be aggregated with the identity shifts necessary in taking on a new way of being a teacher. For example, if I gleaned evidence that learning to teach mathematics with CI was difficult for teachers, I wanted to be reasonably sure that the difficulty was learning a new pedagogy, not learning to teach for the first time.

Among the experienced teachers in this study, there was diversity in gender, race, grade levels taught, types of locations in which they taught, and years of experience (from eight to thirty years). However, I did not study new teachers; therefore, what I have learned about teachers' learning may or may not apply to new teachers.

Another element I limited was the PD context. I chose to only study teachers who were had gone through a course on teaching mathematics with CI. Focusing on teachers learning to use CI to teach mathematics had its affordances. Teaching mathematics with CI in the ways recommended in the PD requires teachers to take a broad view of mathematics, to rethink assumptions about mathematical competence, to rethink their roles as a mathematics teacher, to analyze curriculum, learn new interventions, reflect on academic and social status among students, and more. Because it is so comprehensive, it is quite likely that many teachers would need to make many changes in how they identify in order to succeed. It is also probable that activities such as rethinking what it means to be mathematically competent would have an effect on teachers' views of their own mathematical competence (which may account for Kelly's turning point). Therefore, it is a likely context for seeing changes in ways of identifying.

Of course, although I have reasons to hypothesize that any time teachers are asked to implement new practices there will be implications for teachers' ways of identifying. However, how and for whom this may happen in the context of other PD courses, curriculum guides, or reforms is outside of the scope of this particular study.

Another limitation is due to the nature of participation in the study itself. Teachers were asked to participate if they indicated that they intended to implement CI to teach mathematics during the time period of the study. Of course, teachers were informed of

their rights to discontinue participation. However, knowing that a researcher would be coming to talk to them about their use of CI to teach mathematics might have been a reason they continued to do so. At the end of the study, all teachers indicated that they were glad that they were implementing CI to teach mathematics and that they intended to do more after the study. However, how much study participation actually motivated them to teach the lessons they taught is unknown.

Finally, I will describe a limitation in the analysis of Chapter 5 in particular. In that chapter, I compared teachers' stories of their teaching with CI to one of the ways I noticed them identifying as teachers. The limitation of this is that I downplayed the dynamic nature of identifying in order to look for connections between stories. That is, I fear that readers may see these teachers as essentialized and two-dimensional. It is the case that the teachers identified in many different ways, even though I only highlighted one. The result is a version of the story that is over simplified.

Implications

The results of this study have implications for future research, teacher professional development practice, and policy. First of all, theories about the stability of teaching practice are incomplete (at best) and disrespectful (at worst). They are incomplete because of a lack of attention to the difficult identity work that is required for teachers to change their practice. In order to be complete, theories of teacher learning need to take into account issues of identifying, including the loss that may be experienced as teachers seek to put aside previous ways of identifying and are identified differently by others and the crises that may arise as teachers seek to integrate identities. They are disrespectful because, in assuming that teachers are not making the changes professional

developers might expect, that it may be that they did not understand the proposed changes or harbored some bad beliefs or incorrect knowledge. Instead, seeing teachers in the midst of change as engaged in integrating identities helps to explain why changes may sometimes seem slow, incomplete, or inconsistent. However, those are all a part of the difficult work of adding new teaching practices to a teacher's repertoire.

Instead, studying teachers' narratives of practice assumes that teachers are making sense of their teaching and speaking about it in purposeful ways. It is a method that captures multi-dimensional aspects of the lives of teachers, including cognition, social interactions, cultural contexts, linguistics, emotions, and more. Without deep and careful listening to these teachers, I might have assumed that they were not understanding Complex Instruction, mathematics, or their students. Therefore, more studies of teachers' narratives are warranted.

This finding has implications for teacher professional development. The evaluation and assessment of professional development is implicated because traditional ways of assessing teachers' changes in practice often overlook the identity integration that is required for teachers adding new teaching practices; therefore, decisions about PD made on the basis of those assessments may be problematic. Another implication is that people who support teachers' learning in practice, including administrators, math coaches, and professional developers should be aware of this identity work and provide support as teachers experience it. Additionally, more work needs to be done in order to invent ways to support and mentor teachers that are working toward learning new practices. Perhaps, with support, these experiences could be leveraged to extend teachers' learning of the practices they are implementing.

Additionally, narrativizing experience is one way in which teachers continue to make sense of their practice (Ochs & Caps, 2001). Therefore, as teachers participate in narrative studies, they are continuing to refine their understandings. As such, including teachers' narratives as a part of PD courses or other teacher learning activities seems desirable. One benefit of doing so would be that it would allow facilitators of PDs to better learn about teachers in order to draw connections between how they identify and the practices being recommended. Another reason is that it could provide another opportunity for teachers to make sense of their practice.

Much has been said in recent times about the need to scale up research in mathematics education. I argue that, in the midst of such efforts, the use of narrative methodologies to study teachers and teacher learning be continued. Especially needed are longitudinal studies of the implications of reforms on teachers' lives and practice. In this study, I was able to see the ways in which teaching with CI changed the ways that the teachers identified, and see some of the interplay between teachers' identifying narratives and their narratives of teaching practice. However, how the teachers will continue to make sense of and implement CI as other reforms are recommended and new PD courses are experienced remains unknown.

New understandings of teachers' ways of identifying as they implement new pedagogies have implications for policy as well. New calls for reform of mathematics education seem to be issued regularly. Early on, teachers were asked to be hands-on teachers, then discussion-based teachers, problem-based teachers, Cognitively Guided Instruction (Fennema, etal 1995) teachers, and now Complex Instruction teachers. Teachers are constantly experiencing new waves of PD, curricula, or other

recommendations in their particular districts as well. Asking teachers to routinely shift their ways of identifying and become new kinds of teachers has consequences. Based on this study, it is likely to result in discomfort and conflict between teachers' new and previous ways of identifying. Teachers may need to integrate those two ways of identifying. Therefore, it is not surprising that teachers may blend together ideas from these waves of reform in ways that were not intended by reformers. Attention to what it takes for teachers to become new kinds of teachers is necessary in order for reforms to be effective, of course. Perhaps, when recommending changes in practice, reformers and professional developers can take some of the responsibility for explicating the ways new practices can be integrated with previous ones. It is possible that doing so might lessen the burden of integration work on teachers, by demonstrating how new ways of identifying as a teacher can be integrated with previous ways.

Directions for Future Research

I intend to continue this line of research in the upcoming years. There are a number of problems and questions that have been raised for me as I carried out this study, which I will pursue. In this section, I will outline a couple of ways in which I plan to continue this research.

First of all, I have hypothesized that the CI mathematics PD course itself had particular characteristics that made it a place where shifts in ways of identifying would be seen. However, there are theoretical reasons to believe that all learning and changes in practice would be intertwined with new ways of identifying. Therefore, a similar studying in and after one or more other PD contexts would be necessary. Carrying out a similar study with teachers who are newly implementing Cognitively Guided Instruction

(Fennema etal, 1995), for example, might help me to understand the aspects of the CI mathematics course and CI as a pedagogy that impacted the relationship between teachers' ways of identifying and implementation of the practices.

Another extension to this research would be to extend it to different demographic contexts. I have reported that the teachers in this study came from rural, suburban, and urban contexts. However, the urban context was in a mid-sized, Midwestern city (not a large metropolitan area), the suburban schools were suburbs of this town, and the rural school was within a thirty-minute drive of a research university (not in a remote location, therefore, teachers there had access to a plethora of university related PD and research experiences). My experience in rural areas that are more remote leads me to wonder about a place-based interrelation between identifying and reactions to reforms. A common theme among my conversations with rural teachers is the perceptions that reformers (and policy-makers in general) are unaware of, or simply do not care about, their teaching contexts. Therefore, I hypothesize that it is likely that teachers in more remote locations may react very differently to suggestions for reform, and that continuing this line of research in that context would yield a broader picture of teacher learning.

In addition, there are other lines of analysis that I intend to pursue within this particular set of data. In analyzing the data for this study, I was particularly drawn to look at instances where teachers' emotions seemed to be most obvious. For example, when teachers were uncomfortable, or confused, or angry, or excited, I noticed. In particular, the emotion of fear may be a particularly immobilizing emotion for teachers (fear of not passing tests, fear of being perceived differently by administrators, etc.) How emotions play into a study of teacher learning is something about which I plan to theorize.

Another line of inquiry I will pursue within this data set is a further analysis of the ways teachers' discourses of teaching changed over the data collection time period. Because learning may be defined as a change in discourse (Sfard, 2008), and because learning and identifying are tightly interwoven and often the same thing, studying teachers' ways of identifying has been studying a part of teachers' learning. However, there are other aspects of changes in discourse that could be studied. Whether teachers' ways of talking about mathematics as a discipline changed, or their ways of speaking about students, or their descriptions of their teaching context are places I may begin this process. Additionally, looking at how those ways of speaking are related to teachers' ways of identifying is an area for further analysis. It makes sense, for example, that if a teacher develops a new understanding of her role in her classroom, she will also see the roles of her students differently. This is something I would like to study in the future.

Conclusion

Teachers' learning, like any learning, changes the learner. It changes the way that the learner can participate in communities of practice, it changes the discourse of the learner, and it changes the way that the learner constructs his or her identity in the telling of narratives.

I have argued that this story in teachers' lives parallels other stories of schooling and shifts in ways of identifying that resonate with many of us. In "Of the Coming of John" by W.E.B. DuBois (1903/1994) and in the movie *Educating Rita* (Cartilidge & Gilbert, 1983), going to school changed the learners and how the learners were perceived by significant others.

In the same way, teachers who participated in the CI mathematics course and embraced CI as a mathematics pedagogy changed how they identified as teachers and, in at least some cases, how they were perceived by others such as their students and their colleagues.

Teachers learning, like all learning, though desirable, can be a dangerous undertaking. Seeing teachers as a means to an end (instead of being concerned about teachers themselves) might lead those of us with an interest in mathematics education reform to simply view teachers as conduits of reform (Featherstone, 2005). In doing so, we may rashly push teachers from one reform to another, without attention to the struggles inherent in becoming a new kind of teacher, then another, then another. And yet, of course we want teachers to continue learning and improving their practice, because we care about the lives and learning of students in their classes.

As a partial remedy to this ethical dilemma, I recommend that teacher PD practitioners, administrators, researchers, and policy makers elicit and deeply listen to teachers' narratives at every step of the way, from the conceptualizing of new teaching practices to teachers' consideration of new practices, to their ongoing implementations of them. The result will be a more ethical and humane approach to teacher learning and mathematics education reform.

APPENDIX A: INTERVIEW PROTOCOL FOR PHASE I LIFE STORY INTERVIEWS

(Adapted from Drake, Spillane, & Hufferd-Ackles, 2001)

I. Background Information
   a. How many years have you been teaching?
      i. In what types of school environments (e.g., suburban, urban, rural)
      ii. What grades have you taught?
   b. What type of teaching certification do you have?
      i. Do you have a mathematics major or minor?

II. Mathematics
   a. One of the things I often do with students is to ask them to write their mathematics autobiographies. I'd like to hear about your math autobiography. Tell me about your experiences with learning mathematics. (Possible prompts: What are some adjectives that describe your experiences with learning math? What are some feelings you had when learning math?
      i. Tell me about a time when you felt (one of the things mentioned in the last question). (Possible prompts: where did that happen? Who was involved? What did you do? What were you thinking and feeling? What effect did that have on you?)
      ii. What's another event that stands out to you as important in your math autobiography? (Possible prompts: where did that happen? Who was involved? What did you do? What were you thinking and feeling? What effect did that event have on you?)

III. Teaching Mathematics
   a. How would your students describe you as a math teacher and why?
      i. Can you tell me about an event that happened that leads you to believe students would describe you as (one of the ways the teacher said he/she'd be described by students)?
   b. How might your colleagues describe you as a math teacher and why?
      i. Can you tell me about an event that happened that leads you to believe your colleagues would describe you as (one of the ways the teacher said)?
   c. Describe yourself as a teacher of mathematics.
      i. Why do you think that?
      ii. Tell me about an experience that leads you to describe yourself as (one of the ways he/she described him/herself). (Possible prompts: What were you trying to do? Who was involved? What were you thinking and feeling? What effect did that have on you?
   d. Tell me about your experiences as a teacher of mathematics.
      i. What have these experiences been like for you?
      ii. What is an example of how they were like (the way he/she just

describe them)? (Possible prompts: where did that happen? What did you do? What were you thinking and feeling? What effect did that have on you?)

e. How have you learned about mathematics teaching?
    i. What was an experience that was important to you in learning about teaching mathematics? (Possible prompts: where did that happen? Who was involved? Was that a part of your formal teacher education? What did you learn from that? How did that change your thinking about mathematics teaching and learning?)

IV. The Complex Instruction Workshop
    a. Why did you decide to participate in the Complex Instruction workshop last summer? (Possible prompt: What were you hoping to learn? What were you hoping would happen there?)
    b. I'd like you to reconstruct the experience of the workshop for me so I can see what the experience was like from your point of view. Tell me the story of what happened there for you. (Probes: What kinds of activities did you engage in? What was the nature of the conversation? What did that feel like for you?)
    c. Describe an event from the workshop that stands out in your mind as important to you.
        i. Why was it important? (Possible prompts: What happened? What were you thinking and feeling? What effect did it have on you?)
    d. What did you learn in the workshop?
        i. What event or events helped you to learn that? (The event could be something structured or could be something like an informal conversation).
            1. What was it about that event or those events that helped you to learn that?

V. Effect of Complex Instruction on Your Practice
    a. I'd like you to think about your mathematics teaching practice before the Complex Instruction workshop and after the workshop. How do those compare and contrast with each other? (Possible prompts: Are there differences in the activities you choose to use with your students? In the things you think about as you plan? In the things you notice in the classroom?)
        i. Why do you think those things changed (or did not change)?
            1. (If the teacher reports making changes)
                a. What was it that happened during the workshop that caused you to make those changes?
                b. What factors outside of the workshop have influenced the changes you've made?
                c. Tell me about an example of something that happened in your classroom when you were trying

a technique/strategy from the workshop. (Possible prompts: Why do you think that happened? What did you do? What did you do differently than you would have done before the workshop? What were you thinking about when you did that? How do you feel about that?)

d. How have your students responded to the changes in your teaching practice?
e. Tell me about an example of (student response mentioned above). (Possible prompts: Why do you think he/she/they responded that way? When did that happen?)

2. (If the teacher reports *not* making changes)
   a. Why do you think you haven't implemented the strategies/techniques recommended in the workshop?
   b. What was it that could have happened within the workshop that might have influenced you to implement the recommendations?
   c. What factors outside of the workshop have influenced you in this way?

VI. Goals For Mathematics Teaching and Learning in the Future

a. What are your goals for teaching mathematics?
   i. Why is that a goal for you?
   ii. What things do you already do to reach these goals?
      1. Describe an event that illustrates this. (Possible prompts: where did that happen? Who was involved? What were you thinking and feeling? What did you do?)
   iii. What would you still like to learn about teaching mathematics?
      1. How will help you to be a better mathematics teacher?
   iv. What types of professional development would be helpful to you?
   v. Five years from now how do you see yourself as a teacher of math? What kind of a teacher would you like to become? Why? (Possible prompts: Why do you think that is important? What do you plan to do to learn about that? What do you see being the outcome of that?)

APPENDIX B: PROTOCOL FOR PHASE II INDIVIDUAL INTERVIEWS

These interviews will be semi-structured. Other questions may be asked to follow up on the participants' answers.

Interview I:

1. Your Classroom Since the Workshop:
    a. Tell me about your experiences with teaching mathematics so far this year. Possible prompts:
        i. What have these experiences been like for you?
        ii. What is an example of how they have been like (the way he/she just described them)?
        iii. What are you learning from these experiences?
    b. Have you done any groupworthy tasks since the CI workshop?
        i. If yes, possible questions:
            1. What have those experiences been like for you?
            2. What is an example of how they have been like (the way he/she just described them)?
            3. How do you think your students would describe you when you're teaching using CI? How would you describe yourself?
            4. What are you working on? What are you wondering about?
        ii. If no, possible questions:
            1. Tell me more about why you've chosen not to use CI.
            2. How do you think this year's students would describe you as a teacher? How would you describe yourself as a teacher this year?
            3. Has your teaching changed in other ways since the CI workshop? If so, in what ways? When I asked you about doing this interview, you expressed an interest in using a CI lesson to teach math. What would you need in order to do this? (A lesson, resources, time for planning?)
2. Planning a groupworthy task
    a. When I asked you about doing this interview, you said that you would be interested in teaching a math lesson using CI. What have you planned (or thought about) so far in regards to this lesson?
        i. Talk me through what you expect will happen during this task. Tell me the story of how you expect this to go. Possible prompts:
            1. What specific math content do you want students to engage with in this CI lesson?
            2. What groupworthy task are you considering using for this lesson? What makes it groupworthy? What 'smartnesses' do you expect that this groupworthy task will draw on?
            3. How are you thinking about this task in regards to disrupting status in the classroom? How have you designed

the task (or can you design the task) to attend to issues of status?

4. What are the instructional strategies you will use while teaching using this task? Will you use norms? Roles? Status interventions?

b. If you had an ideal situation (with all the resources, time, support, knowledge, etc. that you would need), is this how this lesson would look? What would be different?
c. What assistance would you like with getting this task prepared, if any? (Do you need any materials? Do you need copies made? Do you need classroom resources or ideas for tasks?)
d. Do you have a lesson plan (notes or jottings are fine) I can keep? Can you email me a lesson plan before you teach this lesson?

3. Preparing for the next interview
   a. When you and I meet again, it will be after you have taught the lesson, to talk specifically about this particular lesson. In order to do this, I would like you to collect an artifact during the lesson so that you can use them to help you think about what happened during the lesson and how it went. (Examples of artifacts include video or audio of the lesson, student work, your own journaling right after the lesson, students' written reflections on the lesson from right after or a while after the lesson, student test or quiz items given later which cover the content of the lesson, etc.)
      i. What type of a teacher are you trying to become? Is there anything in particular that you would like to learn about your own practice by teaching this lesson? If so, is there a certain type of artifact that you could collect and study to help you learn more about that?
      ii. Do you need any assistance and/or resources in order to collect these artifacts? (For example, video equipment and/or a videographer, photocopying, etc.?)
      iii. When you bring the artifacts to our next conversation, make sure you deidentify students as much as possible. (Cross their names off of student work, etc.)
   b. What would be a good time and place for our next interview?

Interview 2:

1. The CI lesson
   a. What did you notice while you were teaching the lesson? Possible prompts:
      i. What happened? Tell me the story of this lesson. Refer to the lesson artifacts if they help you to tell the story.
      ii. How would your students tell the story of this lesson? How would they describe you when telling the story of the lesson? How would you describe yourself?
      iii. How are you feeling about the lesson? Why?
   b. Tell me about an event that seems important to you in this lesson. Possible prompts:

i. What happened? Who was involved? Why do you think that happened? What were you thinking/feeling at the time? Are you thinking differently about that event now?

c. Tell me about the task and the task card. Do you still think it is groupworthy? Why or why not? Tell me about an event that happened that makes you think that.

d. What instructional strategies did you use during the lesson?
    i. Tell me more about what happened when you used that strategy.
        1. Why did you choose to use it? What happened? Did you get the outcome you expected? How are you thinking about that now?

e. What did you notice about status during the lesson?
    i. Tell me about something that happened that led you to believe there was a status issue within a group? (Or alternatively, that led you to believe there was not a status issue within a group?)
        1. What happened? Who was involved?
        2. How did you respond? How did the students respond?
        3. What were you thinking and feeling about that at the time? How are you thinking and feeling about that now?

f. Have you had an opportunity to review the artifacts that you collected about the lesson?
    i. If so....
        1. What did you notice when studying the artifacts?
        2. Which of your artifacts was most helpful for you in thinking about your practice using CI?
            a. What did that artifact help you to see?
            b. What is it that you learned about your practice?
            c. What is it that you learned about yourself from this artifact or from teaching the lesson?
    ii. If not....
        1. Take some time to review the artifacts during this interview.
        2. What did you notice when studying the artifacts?
        3. Which of your artifacts was most helpful for you in thinking about your practice using CI?
            a. What did that artifact help you to see?
            b. What is it that you learned about your practice?
            c. What is it that you learned about yourself from this artifact or from teaching the lesson?

g. In the pre-interview, you said that you were trying to become a more (insert what was said) teacher. How did that go in this lesson? Tell me about a time when you were (or were not) more (what was said) than before?

h. What would you like to work on or learn about next, in terms of teaching mathematics using CI?
    i. Why is that important for you?

ii. What type of teacher are you trying to become? How will that help you become the kind of teacher you're working to be?
iii. What types of support and/or professional development could help you to do this?

APPENDIX C: ROUND ROBIN PROTOCOL FOR TEACHER DISCUSSIONS

Stories of Complex Instruction
Task Card

Each person was asked to think about and be ready to share a story about teaching a mathematics lesson using Complex Instruction (CI). The story may be about a problem you encountered, something you are puzzling over, or something you are celebrating. Each person should tell the group what it is that you would like them to help you think about when they hear and discuss the story.

The Task:
The task is for each person to share a story of practice and discuss it with the group, for the group to think together about why things happened during the lesson, and for the group to summarize their learning and questions about and across stories. To do this:

- First, take a couple of minutes of private think time for group members to organize, think about, or remember their story and what they would like the group to help them think about.
- Then, use the following "Round Robin" protocol for telling the stories:
    1. Person #1 tells a story about a lesson or something that happened during a lesson using CI. Others in the group listen, but do not respond yet. (If you have something that you want to remember to say or ask, jot it down.)
    2. The group talks about Person #1's story, focusing on figuring out what was happening in the classroom and hypothesizing why.
    3. Repeat numbers 1 and 2 above with Person #2, Person #3, and Person #4 sharing their stories and the group discussing them.
    4. Each person's story should get about 20 minutes of group time, including both the storytelling and the group discussion around it.
- When every group member has told a story and the group has discussed them, the group should summarize find questions that occurred across more than one story, and talk about why those might be important.

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