ABSTRACT

Title of Document: TEACHING MATHEMATICS THROUGH AN INTEGRATED CARING APPROACH: EXAMINING THE PROCESS OF BUILDING PEDAGOGICAL RELATIONSHIPS IN ONE FOURTH-GRADE CLASSROOM

Nancy Tseng, Doctor of Philosophy, 2014

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Although there is wide consensus in the field of mathematics education that the teaching and learning of mathematics is a social, interactive, and relational practice, less attention has explicitly examined the role of the student-teacher relationship in the classroom or why this relationship matters for student learning. A central goal of this dissertation was to understand how teachers build productive working relationships with their students through their mathematics instruction and investigate how this relationship influences mathematics learning, with particular respect to student participation and mathematical dispositions. Using practitioner inquiry and design-based research methods, I took up the role of teacher-researcher to detail and surface the work involved in establishing pedagogical relationships that aim to support ambitious and equitable student learning outcomes. I designed an organized pedagogical approach to mathematics practice called an *integrated caring approach* (ICA) and implemented this approach in one fourth-grade classroom during a 12-week classroom-based intervention. Drawing from the theoretical lens of care, the framework of ICA conceptualizes the work of building relationships along the three dimensions of personal, mathematical, and political care. Primary data sources include a teacher-reflective journal, transcripts of audio-recorded lessons, and student surveys and interviews, which were contextually supplemented by lesson plans and student artifacts. Findings reveal that pedagogical relationships served as an instructional resource that enabled me to make opportunities to learn more accessible for students and attend to students' mathematical experiences in the classroom. Analysis indicates the instructional practices that emerged from ICA supported students' willingness to participate in mathematical discussions and fostered the development of positive student dispositions. Findings also suggest that students' experiences with ICA varied across the classroom and were influenced by their conceptions of the discipline and mathematical competence, peer relationships, and the recurrent presentation of learning opportunities during the intervention. This research provides insight into the deliberate and complex work involved when teachers strive to establish and maintain productive relationships with their students in service of ambitious and equitable learning outcomes. Moreover, this study identifies caring pedagogical relationships as a potentially valuable instructional mechanism to make opportunities to learn more accessible for students in mathematics classrooms.

Keywords: pedagogical relationships, elementary mathematics, mathematics education, teacher education, care theory, practitioner inquiry

TEACHING MATHEMATICS THROUGH AN INTEGRATED CARING APPROACH: EXAMINING THE PROCESS OF BUILDING PEDAGOGICAL RELATIONSHIPS IN ONE FOURTH-GRADE CLASSROOM

by

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This work is dedicated to the teachers, students, families, and staff of Glenwood School, where I spent nine extraordinary years as a teacher. You are forever on my mind and in my heart.

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CHAPTER 1: INTRODUCTION

It has been suggested that the researcher is the most important instrument in a qualitative study (Corbin & Strauss, 2008; Denzin & Lincoln, 2005; Eisner, 1998). That is, the experiences, perspectives, and goals of the researcher influence the framing, decision-making process, and analysis of the study. Eisner (1998), in particular, argues:

> Each person's history, and hence world, is unlike anyone else's. This means that the way in which we see and respond to a situation, and how we interpret what we see, will bear our own signature. This unique signature is not a liability but a way of providing individual insight into a situation. (p. 34)

In the spirit of this tradition, I open this dissertation by sharing my story and providing relevant aspects of my background that have led to my interest in and approach to this research study.

My Story

In many ways, I am your garden-variety elementary teacher who teaches mathematics. By this I mean that my path to the profession is quite similar to and representative of many who enter the field of elementary teaching. I have always found myself drawn to the company of children, and I find their fun-loving and naturally curious dispositions to be an endless source of enjoyment and fascination (and exhaustion!).

I pursued my multiple subject teaching credential from a one-year teacher education program immediately after graduating from college with my bachelor's degree in psychology. Like many pre-service teachers who enroll in university-based teacher education programs, though I am not White, I was young and from a "privileged" and middle class background. Because I would be responsible for teaching multiple content areas in the elementary classroom, my professional education consisted of coursework in several disciplines, including but not specific to mathematics. I do not possess an advanced degree in mathematics and for the most part, my own experiences learning math have been traditional in nature, involving notions of procedures, formulas, efficient strategies, and quick calculations.

My first teaching position was in an under-resourced public school in a highly diverse and low socioeconomic neighborhood. The children in my third grade classroom reflected the rich racial, ethnic, cultural, and linguistic population of the neighborhood and of the northern California landscape more broadly. I began my teaching career one year prior to the implementation of *No Child Left Behind* (NCLB, 2001), thus I spent the majority of my time teaching in an atmosphere of high-stakes testing and accountability. And like so many who work with young, bright children, I brought to my work an idealistic yet naïve assumption that developing positive relationships and providing a warm and caring milieu in which to learn would, in and of itself, be enough to support and engage my students in learning content well and enjoyably.

But it is here that my story begins to deviate from other elementary teachers. During my first year of teaching, I joined a collaborative team of three veteran teachers (appropriately nicknamed “The Dream Team” by others at the school) who had taught together for several years and had over 40 years of cumulative experience. The team promptly took me under their wing, mentored, and shared their expertise with me. Therefore, countering the notion that teachers who work in high-poverty public schools frequently work in isolation (e.g., Bryk, Lee & Smith, 1990), “The Dream Team” provided me with a sense of community and cohesion. And although the members of the team fluctuated over the years, I remained in the same teaching position for nine years, affording me the opportunity to become familiar with the same grade-level content and standards for an extended period of time, as well as develop connections to the surrounding community.

I mentored a teacher intern from the local university-based teacher education program during my third year of teaching and through this intern, I developed a relationship with a mathematics education professor, Rebecca Ambrose, who conducted a study on students' mathematical thinking in my classroom the following school year. I observed her teaching monthly geometry lessons to my students throughout the entire academic year. This was my first introduction to open-ended problematic tasks and student discussions grounded in mathematical ideas, and seeing the ways in which my students responded to this approach provided a glimpse into how these instructional practices provided more opportunities for my students, my "low-performers" in particular, to engage and participate in the classroom. I wondered about how to improve my own mathematics teaching and through Dr. Ambrose's mentorship, I completed a Masters program in education (with an emphasis in mathematics education) as a part-time student while also continuing to teach third grade full-time.

During my coursework, I was introduced to the work of Ball (1993), Boaler (1998), and Stein, Grover, and Henningsen (1996) (among others), and I began to see how far removed the learner-centered mathematics pedagogy outlined and advocated for in the research literature was from my own traditional and teacher-centered experiences as a learner and teacher of math. This led me to ruminate over why there appeared to be a gulf between the kinds of mathematical practices I was reading about in my courses and the kinds of instruction I was seeing (and enacting myself) in school contexts. And over time, I also sensed the ways in which my own limited mathematics background and knowledge restricted the ways I wanted to teach and the kinds of learning opportunities I could substantively provide for my students. Furthermore, it was not fully clear what this new knowledge and awareness meant for me on a pragmatic level. That is, knowing when and how to access, translate, and use these new ideas during interactive moments with a classroom of eight and nine year olds was far from trivial.

For these reasons among others, I began my journey towards a doctorate in mathematics education as a full-time student, specifically selecting a program with a research agenda at the intersection of equity, race, and mathematics education. I first became aware of the scholarly work of Nel Noddings (1984), a mathematics educator and care theorist, in a foundational mathematics education course at the beginning of the second year of my program. I was particularly captivated by her publication, *Does Everybody Count? Reflections on Reforms in School Mathematics* (Noddings, 1994). Her relational approach and thoughts on mathematics practice in this piece resonated with me immediately both from my lens as a former elementary teacher and from my personal and at times, perhaps, damaging experiences as a mathematics learner.

However, after hearing the perspectives of others during our class discussion and engaging in additional readings related to theories of social reproduction, culturally relevant pedagogy, and critical theory, I began to understand the criticisms leveled against traditional care theory; more specifically, the potential ramifications of "color-blind" caring particularly in relation to students who have been historically underserved in education (e.g., Bartell, 2011; Toshalis, 2012; Rolón-Dow, 2005; Valenzuela, 1999), and how notions of care, when situated in a field dominated by women, could unwittingly perpetuate hegemonic discourse contributing to their disempowerment (e.g., Hauver-James, 2012). Still finding myself intuitively drawn to the theory, however, I was reluctant to dismiss the perspective of care altogether.

During my time at the university, I have been privileged with opportunities to work with both pre- and in-service elementary teachers as an elementary mathematics methods instructor in our university teacher education program and as a summer school professional development instructor for a local school district, respectively. The premise of both the methods course and the professional development began from the assumption that attending to student mathematical thinking was at the core of meaningful mathematics learning. Through my work with these teachers, I saw my past experiences as a practitioner reflected in their stories – a proclivity towards children, a view of elementary mathematics teaching that underestimated the critical role of content, and bubbling tensions and frustrations with how to teach mathematics in a manner that, on the one hand, they had not necessarily experienced first-hand themselves, and, on the other, appeared at times to be at odds with their orientations toward developing positive and supportive classroom relationships with their students.

My interview with a veteran Kindergarten teacher illustrates the overlapping tensions and felt contradictions she grappled with as her practice evolved away from a focus on procedural mathematics towards pedagogy focused on student mathematical reasoning. In response to my question related to how she and her students were feeling about the new practices, Ms. P said:

> [Students are] trying to guess what you want them to say or what you would want them to do. So I think they feel a little bit uncomfortable, and I'm a little bit hesitant. Sometimes I want to over explain exactly what it is that I want them to do so that they are successful, and sometimes it's hard to let them kinda be wrong.

> That's an interesting thing for Kindergarten because when they're wrong right now…you're sort of trying to give them so many opportunities for success that it's hard to just let them travel down an incorrect path. (Ms. P., Classroom Interview, October 25, 2010)

And once again, traces of the interpretive frame of care wove their way into my experiences, this time as an elementary mathematics teacher educator.

For the last few years, I have been in the position of novice teacher educator, encouraging elementary practitioners to implement particular kinds of mathematical practices in their classrooms undergirded by the assumption that doing so will provide all students, particularly students of color and those in high poverty settings, access to more robust opportunities to learn mathematics. Yet, I myself have wondered what teaching in this manner means for the classroom relationship between teacher and student: Does it conflict with what teachers perceive as demonstrating care on their student's behalf ? Does it conflict with what students recognize as demonstrations of care from their teacher?

I have witnessed from classroom observations, however, that the typical ways in which teachers choose to "care" for their students (e.g., by not publicly addressing students' mathematical confusions in an attempt to preserve their self-esteem or leading students through a procedure step by step to ensure success at a mathematical task) constrain the substance of the learning opportunities students encounter and by extension the extent to which they engage with and learn mathematics meaningfully. Of equal importance, these (well intentioned) teacher actions impact the nature of the relationship students develop with the discipline themselves, shape conceptions of what it means to do and learn math, and influence perceptions of *who* can be good at math.

This culmination of my experiences as a public school elementary teacher, graduate student, novice teacher educator, and emerging researcher is how I arrived at this research study. It is also important to note that my own tenuous and somewhat schizophrenic relationship with mathematics (i.e., ranging from being on the "honors" track from elementary through high school to failing my first college mathematics course to being positioned by peers as the "mathy" one in my math methods course as a pre-service teacher) influences my perspective and approach to this study as well. Years later, I have come to the conclusion there were social forces in my experiences that influenced my relationship with the content, played a role in how confident I felt engaging in and learning mathematics, and shaped the construction of my identity as a mathematics learner.

The Study

This dissertation is a study of mathematics practice from a particular lens, the theoretical perspective of care (Bartell, 2011; Hackenberg, 2005a, 2005b, 2010; Noddings, 1984, 1992, 2007). It grows from a desire to understand how teacher-student relationships influence student mathematical experiences in the classroom. I am persuaded by arguments that caring teacher-student relationships can positively influence student learning (Goldstein, 2002; Hackenberg, 2005a,, 2005b, 2010), support the development of strong mathematical identities and dispositions (Gresalfi, 2009; Martin, 2007), and be leveraged to enable equitable learning opportunities for marginalized student populations (Bartell, 2011; Valenzuela, 1999). I am motivated by the notion that a deliberate focus on classroom practice will move research efforts on equity forward

(Gutiérrez, 2002) and provide insight for the teacher education community writ large (Ball & Cohen, 1999; Ball & Forzani, 2009; Lampert, 2010).

This research is organized around two broad strands of inquiry: 1) developing a deeper understanding of how teachers build caring pedagogical relationships with their students as they strive for ambitious (Kazemi, Lampert, & Franke, 2009) and equitable (Jackson & Cobb, 2010) student mathematical outcomes in the classroom; and 2) examining the ways in which these relationships matter for student learning, with particular respect to students' mathematical participation and the formation of positive mathematical dispositions. I contend that forming productive student-teacher relationships are foundational in the work of teaching mathematics. As Lampert (2001) specifies, these relationships are "fundamental *resources*" (p. 430, emphasis added) a teacher utilizes to accomplish her instructional goals. Moreover:

> The work that is entailed in maintaining these relationships is not something a teacher does because she has a friendly disposition, but because she is identifying and sharpening the essential tools of her trade. (p. 431)

In an effort to detail and surface the work involved in these relational aspects of practice, I take up the role of teacher-researcher (Cochran-Smith & Lytle, 1993) in this study to implement an organized pedagogical approach to mathematics practice that I call an *integrated caring approach* (ICA), which I describe in further detail in Chapters 3 and 4.

Organization of Dissertation

I opened this dissertation by describing my positionality as a teacher-researcher and the practical problem that led to the conceptualization of this dissertation. In Chapter 2, I frame the process of mathematics teaching and learning through a lens of *opportunity to learn* and define the problem of how providing strong opportunities to learn mathematics in the classroom does not, in and of itself, guarantee positive mathematical outcomes for all students. This "black box" between classroom practice and mathematics learning points to the need to maintain "a dual focus on what teachers do and how that is experienced by students" (Franke, Kazemi, & Battey, 2007, p. 230), identify instructional mechanisms that make it more likely for students to engage as active participants in mathematics classrooms, and uncover reasons that account for why students choose to take up (or not) these mathematical opportunities to learn. In addition, viewing mathematics practice from the theoretical lens of *care* (Bartell, 2011; Hackenberg, 2005a, 2010; Noddings, 1984) provides a different conception of mathematics practice and an opportunity to examine how caring student-teacher relationships potentially serve as an instructional mechanism that lead to more equitable student outcomes in the classroom.

The first line of inquiry begins in Chapter 3 where I turn to the theoretical question of how pedagogical relationships serve as an instructional mechanism to support student mathematics learning. The discussion in this chapter is guided by the following research questions: *How do students and teachers build caring pedagogical relationships through the teaching and learning of mathematics? How does this relationship influence student mathematics learning?* In this chapter, I present a theoretical framework for examining the role of pedagogical relationships in mathematics classroom called an *integrated caring approach* (ICA) to mathematics practice. This framework posits that teachers form and maintain productive working relationships with their students through three interrelated dimensions of care: personal, mathematical, and political. In this section, I elaborate on these dimensions and examine how they contribute to the formation of student-teacher relationships that are both interpersonally and academically strong.

The theoretical line of inquiry provides the groundwork for the empirical line of inquiry in the remainder of this dissertation. Specifically, guided by the theoretical framework of ICA, I take up the role of teacher-researcher and design and implement a pedagogical approach to mathematics practice that concurrently aims to support equitable participation in the classroom, cultivate positive student mathematical dispositions, and enable the formation of productive student-teacher relationships. After describing the data and methodology of the classroom-based intervention in Chapter 4, the empirical investigation in Chapters 5 and 6 is guided by the following research questions: *How does an integrated caring approach influence a teacher's mathematics instruction in one fourth-grade classroom? What caring practices evolve from an integrated caring approach to mathematics instruction? In what ways do these practices open up mathematical opportunities to learn?*

The bulk of the work in these two chapters centers on the practical complexities that arise when one attempts to "know teaching from the inside out" (Lampert, 1999). In Chapter 5, I present the early weeks of the classroom-based intervention and detail the initial work of building productive working student-teacher relationships in the classroom. I describe the process of getting to know the fourth-grade students as a collective class, as individuals and mathematics learners, and the relational complexities that arise when "figuring out where to start in the mathematics, getting to know the students, and planning activities" (Lampert, 2001, p. 51). In Chapter 6, I look at my mathematics instruction across the 12-week classroom intervention and illustrate how the three dimensions of care were reintegrated in my mathematics instruction through the presentation of four caring themes. I illustrate the concrete ways in which caring manifested in my classroom practices, how I leveraged my growing knowledge of the fourth-grade students to create opportunities for students to engage and participate in mathematics activities, and how my practices centered around "teaching students how to learn from the kind of teaching that is going to be happening" (Lampert, 2001, p. 51).

Whereas Chapters 5 and 6 focus on the process of building pedagogical relationships from the lens of the teacher-researcher, I shift to the student perspective in Chapter 7. Having presented the classroom practices students engaged with across the 12-week intervention, I examine the fourth-grade students' mathematical experiences with the pedagogical approach of ICA against this backdrop, paying particular attention to their participation in classroom practices and emerging mathematical dispositions. The discussion in this chapter is guided by the following research questions: *How do fourth grade students respond to an integrated caring approach to mathematics practice? In what ways do fourth grade students' mathematical dispositions shift with their engagement in classroom mathematics practices? What factors do students report as influencing their mathematical experiences in the fourth-grade classroom, with particular attention to their affective responses to classroom mathematics practices?* Analysis reveals that students' participation and mathematical experiences are influenced by their conceptions of the discipline, how mathematical competence is constructed in the classroom, peer relationships, and the recurrent presentation of mathematical opportunity to learn over time. Findings also illuminate that individual students' mathematical experiences varied across the intervention and that some students experience classroom practices in ways that differed from my intentions as the teacher.

In the final chapter, I weave together the analytic threads from the theoretical and empirical lines of inquiry to reflect on the process of building productive working relationships in mathematics classrooms and how student-teacher relationships function as a pedagogical tool. I conclude with a summary and discussion of my analysis and revisit my research questions to consider the main implications of this study and future lines of inquiry.

CHAPTER 2: BACKGROUND AND MOTIVATION

Mathematical Opportunity to Learn

Over the years, research in mathematics education has identified *opportunity to learn* as a critical link between teacher practice and student mathematical outcomes (e.g., Franke et al., 2007; Hiebert & Grouws, 2007). Specifically:

> The emphasis teachers place on different learning goals and different topics, the expectations for learning they set, the time they allocate for particular topics, the kinds of tasks they pose, the kinds of questions they ask and responses they accept, the nature of the discussions they lead – all are part of teaching and all influence the opportunities students have to learn. (Hiebert & Grouws, 2007, p. 379)

In recognition of the importance for students to have access to strong opportunities to learn in the classroom (e.g., Goodlad, 1984), the mathematics education community has identified a number of instructional practices that support student learning of key mathematical ideas. Researchers have consistently gathered evidence of the benefits of instruction grounded in attention students' mathematical sense-making (Carpenter, Fennema, Peterson, Chiang, & Loef, 1989), and there is general consensus that the use of cognitively demanding tasks (Stein, Smith, Henningsen & Silver, 2000) and engaging students in the disciplinary practices of explanation, justification, and generalization support students' conceptual understandings and procedural fluency (Franke et al., 2009). Most recently, these instructional practices and ambitious student goals have been outlined in the *Common Core State Standards* in mathematics (Common Core State Standards Initiative, 2010).

Although framing student mathematical outcomes in terms of access to opportunities to learn (e.g., Flores, 2007; Jackson & Wilson, 2012) has pointed to the importance of high quality instructional practices in the classroom, this dissertation is premised on the claim that providing strong opportunities to learn mathematics is necessary, but insufficient to support all students in learning mathematics. Put simply, "the mere existence of more forceful opportunities does not guarantee they will be taken up" (Gresalfi, 2009, p. 362), and this statement distinguishes between instructional practices that *afford* strong opportunities to learn and practices in which learning opportunities are *realized* in the classroom (Gresalfi, 2009). With the goal of equitable student outcomes in mind, the recognition that all students may not take up classroom opportunities to learn points to the importance for additional research that goes beyond examining whether learning opportunities are simply available in the classroom. The question therefore becomes: How can mathematical opportunities to learn be made *accessible* for all students?

Mathematics Practice Through the Theoretical Lens of Care

Toward this end, the theoretical construct of mathematics *identity* has emerged as an area of focus for scholars interested in investigating how the nature of the interactions between teachers, students, and mathematics influence student engagement and participation in the classroom. Over the years, mathematics education researchers have defined the construct in multiple ways (e.g., Horn, 2008; Martin 2000, 2007; Nasir, 2007). I do not take up that issue here, rather for my purposes, I use the term broadly and suggest the notion of identity:

> …encompasses a range of issues including those that are typically subsumed under the heading of affective factors. These include students' persistence and interest in mathematics and their motivation to learn mathematics. (Cobb, Gresalfi, & Hodge, 2009, p. 41)

Chiefly, identity-focused scholars theorize that students who identify with or develop positive dispositions towards the discipline will be more likely to engage with learning opportunities made available in the classroom (Boaler & Greeno, 2002; Gresalfi & Cobb, 2006; Gresalfi, 2009). From this lens, learning occurs as participants engage more fully with community practices, and a key component of progressing towards central participation within a community of practice is that individuals identify with doing so (Lave & Wenger, 1991).

Research focused on the identities students develop in mathematics classrooms has made insightful progress in conceptualizing instructional practices that have the potential to empower some learners and marginalize others. Nevertheless, the particular ways in which knowledge of students' identities makes its way into mathematics classrooms remains underexplored in the current literature base. Theories of identity do not explicitly point the way for how these abstract ideas can be taken up in practice or how mathematics instruction can be structured around notions of student identities.

In an effort to address this limitation, I contend that *theories of care* (Bartell, 2011; Hackenberg, 2005a; 2010; Noddings, 1984) bring a more powerful conceptualization to the discussion. Nel Noddings, whose foundational work on care is most influential in the field, frames *caring* as "a way of being in relation with another, not as a specific set of behaviors" (1984, p. 17). In other words, a caring teacher is not someone who possesses static, desirable characteristics but rather one who can *establish* relationships with students in a number of different contexts.

Attending to student identity formation and caring for students frequently overlap when conceptualizing the nature of productive teacher-student relationships in existing literature. That is, building authentic relationships with students in the classroom draws on notions of identity, race, and culture (Bartell, 2011; Valenzuela, 1999), and such relationships are potentially powerful levers to enable students to take up mathematical opportunities to learn.

What is more, the notion of *caring for* students (Noddings, 1992) is a salient and widely present phenomenon in classroom life and instructional practice. Teachers readily identify care as a lens through which they view their teaching and rationalize their instructional decision-making process (Goldstein, 2002; McBee, 2007; Noblit, 1993; Tarlow, 1996). Attending to who students are as individuals and being responsive to their personal and academic needs is part and parcel of the work teachers do on a daily basis (Kennedy, 2005; Rosiek, 2003). Noddings (1995) also draws connections between identity, caring, and practice. As she explains:

> We need to give up the notion of a *single* ideal of the educated person and replace it with a multiplicity of models designed to accommodate the multiple capacities and interests of students. We need to recognize multiple *identities*. For example, an 11th-grader may be a black, a woman, a teenager, a Smith, an American, a New Yorker, a Methodist, a person who loves math, and so on…but whoever she is at a given moment, whatever she is engaged in, she needs – as we all do – to be *cared* for. (p. 368, second and third emphasis added)

Seen this way, care, relationships, and identity formation are integrally linked. Theories of care, therefore, can serve as an analytic lens and provide guidance for how teachers can establish and leverage strong relationships with their students to concurrently attend to students' emerging identities and their mathematics learning.

Theorizing the Role of Pedagogical Relationships in Mathematics Classrooms

In this study, I explicitly forefront the student-teacher relationship and bring what frequently lingers in the background in examinations of mathematics practice to the foreground. I contend that pedagogical relationships play a pivotal role in whether and how students learn mathematics, and the kinds of mathematical experiences they have in the classroom. As Schoenfeld and Kilpatrick (2008) argue, "[these] relationships are, in fundamental ways, the bases on which the classroom community is founded and foundations upon which the individuals in it get the work of growing and learning done" (p. 25). Seen this way, the role of theory in understanding how pedagogical relationships are formed in the classroom is critical.

Here, I make a distinction between pedagogical relationships and *caring* pedagogical relationships. Specifically, by virtue of being in the role of student and teacher interacting around content, in my view, all student-teacher relationships are pedagogical relationships. Caring pedagogical relationships, however, are relationships where students and teachers are "in relation with another" (Noddings, 1984), and I argue that students who feel a sense of connectedness to their teacher or who feel *cared for* by their teacher will be more likely to engage and participate in classroom activities.

Put simply, a caring pedagogical relationship potentially functions as a relational mechanism to enable students to take up opportunities to learn (See Figure 1). To be clear, my intent is not to imply that teachers who do not establish caring relations with their students are *un*caring. However, the theoretical use of the term care implies that being in a *caring* relationship with someone is akin to being on the same wavelength with another, not that one has sentimental feelings towards the other. The point I am trying to make here is that teachers who strive to understand their students' classroom experiences through caring relations will be better positioned to work productively with them. In short, caring relationships are *productive* relationships.

Complexities of Building Caring Pedagogical Relationships

Although there is wide consensus in the field of mathematics education that teaching mathematics is a social and inherently relational practice (Franke et al., 2007; Lampert, 2001), less attention has explicitly examined the role of student-teacher relationships in the mathematics classroom or how this relationship influences student learning. Too often "interpersonal relationships are simply an assumed, implicit, contour of the contextual terrain" (Goldstein, 1999, p. 654). Consequently, the relational work involved when teachers strive to establish, maintain and ultimately leverage pedagogical relationships to advance their instructional goals remains "an invisible aspect of practice" (Lampert, 2001, p. 430).

The absence of research on the relational aspects of teaching is problematic for a number of reasons. First, this means there is minimal practical guidance to support teachers in building interpersonally strong *and* academically productive relationships with their students in the classroom. Drawing from Parsons (1951), Labaree proposes that teaching involves a delicate balance between, on the one hand, establishing an emotional link to motivate students to actively participate in learning activities and, on the other, endeavoring to bring about measurable student outcomes. More specifically, it "requires a remarkable capacity for preserving a creative tension between…two opposites, never losing sight of either teaching's relational means or its curricular goal" (p. 230).

Existing research reveals that developing this "remarkable capacity" is inherently complex, especially in light of the multiple professional goals teachers juggle in their work. Kennedy (2005) describes how elementary teachers in her study struggled with "competing ideals of nurturing students who [were] still young and emotionally immature…and of helping them learn important academic content" (p. 25). From these teachers' perspectives, establishing positive relationships with students in the classroom was a "prerequisite" to engender academic learning. Relational dilemmas such as managing student errors, therefore, were particularly troublesome, and teachers "abhorred" the idea of telling students they were wrong. Yet, as Kennedy notes, "students are novices at the subjects they are learning [and] are likely to often be wrong, thus placing teachers on the horns of an agonizing dilemma" (p. 50).

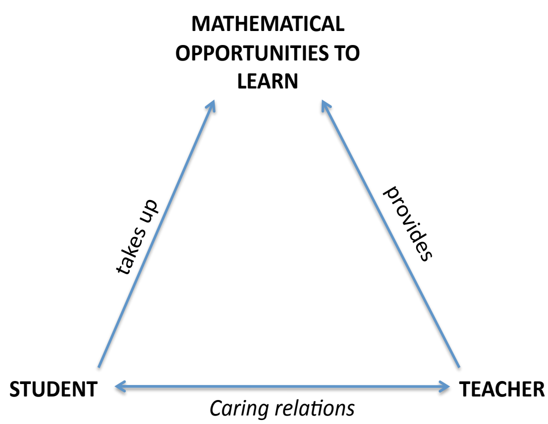

Figure 1. Conceptualizing the role of pedagogical relationships in mathematics practice

Obscuring the work involved in establishing pedagogical relationships can also lead to the faulty assumption that these relationships develop organically in the classroom or that all relationships are necessarily healthy and functional. These assumptions are consequential for equitable student outcomes because "the nature of a teacher's relationship with her or his students impacts whether and how the teacher views a child as mathematically competent; this view, in turn, impacts the subsequent mathematical situations posed to a child to further her or his mathematical understanding" (Bartell, 2011, p. 52). Recent work by Dan Battey (2013) confirms this argument and speaks to the importance of problematizing current conceptions of what constitutes "high-quality" mathematics instruction. Specifically, his findings illuminate that negative relational interactions between students and teachers can foreclose the learning opportunities of particular students, even in classrooms with teachers who exhibit strong mathematics instruction and provide substantive learning opportunities in the classroom on a collective level.

Research Questions

Taken together, the literature and practical dilemmas illustrated above draw attention to the importance of research that focuses explicitly on how teachers establish and maintain relationships with their students with the explicit goal of advancing their mathematics learning. For my purposes here, I use the term "learning" broadly to consider "not only cognitive but also affective [and participatory] aspects of students' mathematical education" (Stylianides & Stylianides, 2013, p. 334).

I argue that the findings from this study hold both theoretical and practical significance, and I seek to develop and examine an "empirically tested and theory-based solution to alleviate problems of student learning" (Stylianides & Stylianides, 2013, p. 334). Thus, while the pragmatic learning goal of the classroom-based intervention is to promote students' mathematical participation in the classroom, it is also a paradigm case of examining the broader phenomenon of teacher-student relationships, how they are established and maintained, and whether and how this relationship can be a pedagogical tool in mathematics practice (whereby a teacher leverages this relationship to support student participation and enable the development of productive mathematical dispositions).

This dissertation is guided by the following research questions:

RQ 1: How do students and teachers build caring pedagogical relationships through the teaching and learning of mathematics?

- How does this relationship influence student mathematics learning?

RQ 2: How does an integrated caring approach influence a teacher's mathematics instruction in one fourth-grade classroom?

- What caring practices evolve from an integrated caring approach to mathematics practices?
- In what ways do these practices open up mathematical opportunities to learn?

RQ 3: How do fourth-grade students respond to an integrated caring approach to mathematics practice?

- In what ways do fourth-grade students mathematical dispositions shift with their engagement in classroom mathematics practices?
- What factors do students report as influencing their mathematical experiences in the fourth-grade classroom, with particular attention to their affective responses to classroom mathematics practices?

CHAPTER 3: A THEORETICAL FRAMEWORK FOR BUILDING PEDAGOGICAL RELATIONSHIPS IN MATHEMATICS CLASSROOMS

Overview

The purpose of this chapter is to articulate a framework for conceptualizing how teachers establish and maintain caring pedagogical relationships with students in service of advancing their mathematics learning, with particular respect to classroom participation and emerging mathematical dispositions. The following research questions drive the theoretical inquiry in this chapter:

- How do students and teachers build caring pedagogical relationships through the teaching and learning of mathematics?
    - How does this relationship influence student mathematics learning?

A synthesis of the current literature base elucidates that the work of building relationships with students can be parsed along three distinct, yet interrelated dimensions of *personal*, *mathematical*, and *political* care. Taken together, I call this framework *an integrated caring approach* (ICA) to practice, and I describe the three dimensions in detail below. On a broader level, the discussion in this section is intended as a partial response to Grossman and McDonald's (2008) observation that the work of building pedagogical relationships "seems remarkably undertheorized" (p. 187) in the existing research base, and "any framework of teaching practice should encompass these relational aspects of practice and identify the components of building and maintaining productive relationships with students" (p. 187). At the local level, the theoretical work in this chapter sets the stage for the subsequent empirical work that follows in the remaining chapters.

The framework of ICA aims for both theoretical and practical relevance. Theoretically, this framework equips us with "specific technical language" (Grossman et al., 2009, p. 2039) to discuss care in theoretical terms, a necessary first step to move beyond the predominant conceptions of care as a sentiment. It also serves as an analytic lens to investigate the relational aspects of mathematics practice; spotlighting how particular classroom practices and instructional mechanisms (features of class activities and aspects of their implementation) enable students and teachers to form relationships in the classroom and examining how this relationship shapes the teaching and learning process.

From a practical standpoint, ICA serves as a pedagogical tool to guide teachers in making use of these theoretical ideas in practice. It is also intended to enable teachers to establish interpersonally strong and academically productive working relationships in the classroom. As Labaree (2000) notes, "there is no guidebook for how to accomplish this for any particular teacher in a particular classroom" (p. 229), and this model is my attempt to provide a conceptual "guidebook" for practitioners and support them in attending to the multiple professional goals involved in their work.

An Integrated Caring Approach to Mathematics Instruction

In this section, I bring together research related to theories of care, student-teacher relationships, and mathematics education – drawing on other areas as needed – and present a framework that demonstrates how teachers can form productive relationships with their students that are both interpersonally and academically strong. As a preliminary to the presentation of the three dimensions of care, I begin by describing the theoretical roots of an integrated caring approach to mathematics practice before turning to each of the three components of care.

To be clear, it is misleading to categorize distinctly these three dimensions – in reality, they are intertwined and interact in essential ways; however, this framework is a useful way of conceptualizing the different components involved in the process of establishing student-teacher relationships. Deliberately unpacking the three aspects of the relationship-building process and "decomposing" complex practice into its constituent parts (Grossman et al., 2009) makes visible the work involved when striving to form interpersonally and academically strong relationships with students.

As a final note, I state from the outset that my use of the words "care" and "caring" throughout the discussion below is intentional. They are not exactly interchangeable terms in my view and hold different meanings depending on their use. Cook and Brown's (1999) distinction between explicit and tacit knowledge may be a helpful way of specifying the distinction between the two terms. From their perspective, explicit knowledge is a tool that one possesses, while tacit knowledge is deployed during action. Therefore, in this context, teachers draw on their knowledge *of care* to form relationships with students, however, the actual work of *caring for* students is a dynamic activity that occurs during interactive moments in the classroom between student and teacher. Both forms of knowledge are "complementary and mutually enabling" (p. 383) and can "often be used as an aid in acquiring the other" (p. 385). In other words, the three dimensions of *care* in ICA serve as a tool for the mechanism of *caring*, whereas the in-the-moment *process of caring* can subsequently filter back to support a teacher in knowing how to *enact care*.

Caring Foundations

An ethic of care (Noddings, 1984) begins from the premise that *caring* is a particular kind of relation between two individuals rather than a personality trait or a sentiment one feels towards another. Student-teacher relationships are cultivated through the phenomenological processes of *engrossment* and *motivational displacement* where teachers strive to view things from both her[1] lens and that of the student. Building pedagogical relationships begins with engrossment where the teacher attends to and accepts the feelings and experiences of the student. As Noddings depicts, the teacher's "energies flow toward [the student]'s needs" (2007, p. 2), and rather than assuming what the student is experiencing, she engages in feeling *with* him and attempts (as much as possible) to take on his experiences as her own. During motivational displacement, the teacher puts aside her own motives and, in an effort to be responsive to the individual student's experiences, *enacts care* for him by, for example, organizing learning activities to enhance the student's classroom experiences.

Importantly, it is the constructs of engrossment and motivational displacement that are the hallmarks of caring, not the depth of feeling. That is, the teacher does "not need to establish a deep, lasting, time-consuming personal relationship with every [student]. What [she] must do is be totally and nonselectively present…as [he] addresses [her]" (1984, p. 180). Seen this way, caring does not necessarily mean getting *along* with a student well but requires getting to *know* a student well – knowing their backgrounds, interests, goals, and personalities, etc. – and leveraging this knowledge to support student

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[1] I refer to the one-caring teacher as "she" and the cared-for student as "he" throughout this section for the sake of clarity. Clearly, both women and men can fill either roles, and I do not intend to contribute to stereotypical notions of femininity and care; I chose these pronouns for ease of communication.

learning and their "growing competence and independence" (Noddings, 1984, p. 24). From the standpoint of an ethic of care, the fundamental goal of education is "to contribute to the complete growth of every child" (Noddings, 1992, p. 170). Caring teachers are motivated by a sense of responsiveness to the student and respectful of his autonomy, meeting him first and foremost as an individual "not as [an] object to be manipulated nor as a data source" (1984, p. 72).

Because care theory is relational at its core, the student's response to the teacher plays an essential role in the relationship-building process. That is, the student must acknowledge or recognize the teacher's enactment of care for the relationship to be formed. Specifically, Noddings (1984) reasons that when the student "feels the recognition of freedom [he] grows under its expansive support" (1984, p. 72) which propels student to engage in learning activities. The student may respond to the teacher's care in a number of ways, but regardless of the response, the student's acknowledgement of the teacher's enactment of care is the sustaining force of the caring relationship.

It is precisely because of the student's unique contribution that caring is viewed as a relational practice, not a sentiment. As Noddings (1984) reflects, "Does this mean that I cannot be said to care for X if X does not recognize my caring? In the fullest sense, I think we have to accept this result" (p. 68). In other words, caring is not about expressing abstract concern for students, and a teacher cannot simply say they care *about* their student. Instead, caring *for* a student "lives in actual relationships and the kinds of historical and contemporaneous interactions and exchanges that nourish them" (Gordon, Benner, & Noddings, 1996, p. 3). In short, caring represents "an action rather than an attribute [and] a deliberate moral and intellectual stance" (Goldstein, 1999, p. 30).

Personal Care

The personal dimension of care refers to the ways teachers form interpersonal connections with their students by attending to who they are as individual persons and their affective and social-emotional responses to learning activities. A body of research indicates that strong interpersonal relationships positively influence children's social and emotional development (Noblit, Rogers, & McCadden, 1995; Stipek, 2006) and are linked to positive learning outcomes (Maulana, Opdenakker, Den Brok, & Rosker, 2009; Stipek et al., 1998). Specifically, students who feel interpersonally connected to their teachers are more motivated to succeed in school (Wentzel, 1998), more engaged in academic learning, and have more positive attitudes towards school and learning (Maulana et al., 2011; Stipek et al., 1998; Valenzuela, 1999).

Specific to mathematics education, research indicates that students who develop personal connections with their teachers are more willing to persist in the face of mathematical challenge (Stipek et al., 1998) and develop positive orientations towards mathematics (Midgley, Feldlaufer & Eccles, 1989; Stipek et al., 1998). For example, Stipek and colleagues (1998) found that students were more likely to engage in mathematical risk-taking because they "did not worry that their teachers' support and positive regard would be withdrawn if they performed poorly or revealed their ignorance" (p. 481). In another study, Midgley and colleagues (1989) examined how changes in teacher-student relations during the transition from elementary to junior high school mathematics classrooms influenced the intrinsic value students attached to the discipline. Consistent with Stipek et al.'s findings, students who experienced similar or higher levels of teacher interpersonal support between the transition reported a rise in their appreciation of mathematics.

Attending to students as individuals. Students report feeling cared for when teachers move beyond class generalizations and take time to get to know them as individuals (Tarlow, 1996; Valenzuela, 1999). Teachers who engage in "open, honest, spontaneous, easy to do, and frequent" (Tarlow, 1996, p. 63) dialogue with their students, or who are perceived as approachable and personally interested in their students are more likely to establish trusting connections in the classroom (Tarlow, 1996; Vogt, 2002). Existing studies indicate that classroom interactions such as making eye contact, actively listening and recognizing students' ideas, and creating activities that make each student feel unique (e.g., identifying special interests, celebrating birthdays, etc.) represent enactments of care on the part of the teacher (McBee, 2007; Tarlow, 1996). Expressing positive emotions, such as enthusiasm or encouragement, also enable students and teachers to develop a sense of connectedness and lead students to respond more positively to the learning activities they engage with in the classroom (Patrick, Alderman, Ryan, Edelin & Midgley, 2001).

Emotional scaffolding. The dimension of personal care is also undergirded by the assumption that social, emotional, and motivational aspects of learning are not peripheral to the learning process, but rather centrally located in and inextricably related to learning (Goldstein, 2002; Gresalfi, 2009; Hargreaves, 2000; Rosiek, 2003). Specifically, emotions "[cannot] be compartmentalized away [and] emotion, cognition and action, in fact, are integrally connected" (Hargreaves, 2000, p. 812). Teachers can enact personal care for their students by, for example, checking in on a student's level of engagement or monitoring the nature of their responsiveness to a particular task by "noticing, being conscious of and attending to the mood and the focus of students [to] bring them into the learning experience" (Tarlow, 1996, p. 66).

This resonates with Rosiek's (2003) notion of *emotional scaffolding* where teachers seek to foster or reduce students' constructive and unconstructive emotional responses to content, respectively, to provide more enriching classroom experiences. Specifically, he argues that the ways in which teachers attend to and influence students' emotional responses to subject matter critically shapes their learning opportunities. In addition, Rosiek argues that teachers' awareness of and attention to the emotional dimensions of student learning is an unrecognized, yet necessary, component of pedagogical content knowledge.

Strong interpersonal connections between students and teachers appear to be particularly relevant in the learning experiences of students who have been historically underserved in the classroom (Furrer & Skinner, 2003; Roeser, Eccles, & Sameroff, 1998). This finding lends credence to the importance for teachers to develop *emotional understanding* (Hargreaves, 2000) towards the classroom experiences of their students. Namely, "if we misunderstand how students are responding, we misunderstand how they learn" (Hargreaves, 2000, p. 1060). This argument converges with Rosiek's (2003) observation that emotional sensitivity is particularly critical when working with students "who find themselves on the cultural margins of school culture, pushed out, chronically unsuccessful, or otherwise disadvantaged" (p. 400). Specifically:

> We would expect the emotions associated with marginalization to affect learning – how could it not? In this way the emotions become not just a consequence but also a part of the institutionalized structure of exclusion. Competent teachers try to find ways to work against the grain of these feelings of exclusion (Cochran-

> Smith, 1991; Delpit, 1995; Ladson-Billings, 1995; Sconiers & Rosiek, 2000). (Rosiek, 2003, p. 401)

In sum, the "interpersonal relationship can be considered a significant factor in cognitive development" (Goldstein, 1999, p. 655), and this statement supports the argument that the personal connections teachers and students form with one another influence student engagement and shape academic outcomes. Central to these studies is the notion that getting to know students personally and seeing them as individual persons (within a collective group of students) is critical to support their learning. From this perspective, caring for another can be seen as a way of acknowledging, respecting, and accepting the other person (Noblit et al., 1995; Noddings, 1984; Tarlow, 1996).

Mathematical Care

The dimension of mathematical care refers to the ways teachers provide students with ambitious opportunities to learn mathematics and attend to their development as mathematics learners in the classroom. Establishing and maintaining productive student-teacher relationships in the classroom necessarily involves forming this relationship around subject matter and attending to the disciplinary relationships students develop with mathematics.

Ambitious mathematics instruction. Teachers enact mathematical care in the classroom by implementing instructional practices that provide students with opportunities to learn mathematics in conceptual and procedural ways. Over the last two decades years, the National Council of Teachers of Mathematics (NCTM, 2000) has advocated for transforming the way the mathematics has traditionally been taught in most classrooms by outlining several content and process goals intended to support students' attainment of both conceptual understanding and procedural fluency. The overall thrust of the movement has been propelled by the recognition that learning procedures and practicing sets of problems does not, in and of itself, support students' understandings of key mathematical ideas. These ambitious student goals have most recently been represented in the Common Core State Standards in mathematics (CCSS, 2010).

Mathematical caring relations. The dimension of mathematical care also recognizes that students' affective and socio-emotional responses to mathematics activities influence their engagement and participation. Therefore, attending to how students are responding to and interacting *with* the mathematics in the classroom is as important as attending to *what* students learn mathematically.

Specific to mathematics education, Hackenberg's (2005a, 2005b, 2010) model of *mathematical caring relations* (MCRs) moves the field towards understanding how teachers can "conjoin affective and cognitive realms in the process of aiming for mathematical learning" (2010, p. 237). She argues that although mathematics teachers may act as carers in a general sense, caring becomes distinctly mathematical when teachers "work to harmonize themselves with and open new possibilities for students' mathematical thinking, while maintaining focus on students' feelings of depletion and stimulation" (Hackenberg, 2005a, p. 45). Establishing MCRs with students requires a "combination of intuitive and analytical activity" (2010, p. 240), whereby teachers remain attuned and responsive to how students are engaging with the mathematics and interact with students in ways that sustain their engagement.

Hackenberg's research (2005b, 2010) illustrates that the nature of the mathematical activities teachers and students form relationships around play a salient role facilitating caring relations. That is, because MCRs are constructed for the purposes of bringing forth and sustaining mathematical learning, teachers pose challenging yet appropriate tasks within a student's zone of proximal development (Vygotsky, 1978). Importantly, teachers do not diminish the cognitive demand of the task (Stein et al., 1996), but remain sensitive and aware of the affective and emotional ways students are interacting with the mathematics and responds accordingly to enable student engagement.

Reflecting the notion of *reciprocity* (Noddings, 1984), a student's response to a teacher's enactment of mathematical care is how caring relations are established (or not) between the two. That is, students demonstrate they have received the teacher's care by "being open to the teacher's interventions and pursuing questions and ideas of interest" (2005b, p. 2), which subsequently stimulates positive and energetic feelings in the teacher and enables her to continue to care. Hackenberg (2005b, 2010) suggests that "successful" MCRs may be particularly influential in promoting the development of productive student dispositions towards mathematics and supporting student self-efficacy.

Taken together, enacting mathematical care involves knowledge of students and mathematics. Knowing a student well *mathematically* undergirds the design of the task and helps a teacher understand how to support their mathematical thinking. Knowing a student well *personally* helps a teacher understand how a student is responding to the task and consider ways to facilitate and maintain their engagement. From this perspective, we see that teachers take deliberate actions and mediate students' relationships with mathematics in ways that are more likely to advance student learning.

Political Care

The dimension of *political care* refers to the ways teachers problematize "caring" discourses, provide students with equitable opportunities to learn mathematics, address issues of identity and power through their mathematics teaching, and care with awareness. Strong student-teacher relationships can be particularly transformative for student populations that have been traditionally underserved in education (Bartell, 2011; Rosiek, 2003; Valenzuela, 1999). For my purposes here, I draw from Jackson and Cobb's (2010) work and define equitable to mean "all students can participate substantially in all phases of mathematics lessons (e.g., individual work, small group work, whole class discussion), but not necessarily in the same ways" (p. 4).

Problematizing "caring" discourses. Scholars who take a critical approach to care theory remind us of the importance of problematizing the assumed benefits of caring relationships between teachers and students (Bartell, 2011; Hauver-James, 2012; Toshalis, 2012; Valenzuela, 1999; Van Galen, 1993). Because definitions and expectations of "appropriate" classroom behavior are culturally influenced, conflicts and misunderstandings occur when teachers and students come from different cultural, racial, and socio-economic backgrounds (Weinstein, Tomlinson-Clarke, & Curran, 2004). For example, Van Galen (1993) points out that existing literature is teeming with ''examples of teachers who may have presumed that they were working in the best interests of their students but who misread situationally and culturally grounded behaviors of students of color, poor children, and female students'' (p. 8). Others suggest that the "seductive and convincing" (Toshalis, 2012, p. 13) nature of caring discourses complicates the development of genuine caring relationships between students and teachers and masks deficit-oriented rhetoric. What is more, these discourses are often difficult to identify due to their subtle and insidious nature and are also reified within larger discursive contexts.

Good intentions notwithstanding, these studies demonstrate that what one thinks it *means* to care, and the ways in which these conceptions reveal themselves in mathematics classrooms can yield unintended and negative consequences. Therefore, caring for students politically requires broadening monolithic or sentimental conceptions of care and explicitly problematizing dominant assumptions at work in the construction of "caring" narratives. In addition, enacting political care compels teachers to take a reflective stance on their actions and consider the ways in which their personal assumptions shape and influence students as individuals and mathematics learners.

Hauver-James (2012) argues that developing relationships with students, particularly when situated in high poverty schools that serve non-dominant student populations, requires the use of caution and humility, or in her terms, *mutuality*. Chiefly, "because we cannot ever truly empty our souls of our own motivations" (p. 167), teachers recognize their own experiences and knowledge are partial and limited and work to develop greater awareness of their students' personal and mathematical experiences.

Equitable mathematics instruction. Enacting political care in the classroom requires providing instruction that is "*equitable* as well as ambitious" (Jackson & Cobb, p. 4, emphasis added). Existing work in the field intimates that instructional practices that aim for ambitious learning goals may unintentionally exclude particular groups of students from non-dominant backgrounds (Jackson & Cobb, 2010; Lubienski, 2000). That is, these practices can potentially exacerbate existing mathematical inequities by "privileging certain forms of discourse and ways of reasoning [or] positioning multiple forms of learning and knowing as 'having clout'" (Diversity in Mathematics Education Center for Learning and Teaching, 2007, p. 407). Jackson and Cobb (2010), for example, argue that the current vision of ambitious mathematics instruction is shortsighted, and that teachers should develop "concrete" practices, such as unpacking key mathematical relationships or making implicit cultural suppositions in mathematical tasks explicit, to support all students participating in the classroom in central ways.

The dimension of political care also recognizes that teaching mathematics is not a neutral activity (Gutstein & Peterson, 2005) and that "the nature of the discipline is inextricably tied to issues of equity more broadly" (Gresalfi & Cobb, 2006, p. 52). As such, the nature of the tasks students grapple with, the types of solutions that are considered "valid", the ways students are expected to participate, and how they are positioned within the classroom sends implicit messages about what is important and valued in mathematics classrooms and in the discipline more broadly (Cobb, Gresalfi, & Hodge, 2009; Franke et al., 2007). Therefore, a teacher's conception of what it means to "do math" and *who* she thinks is capable has direct bearing on classroom practices and, by extension, the kinds of learning opportunities made available for students.

Attending to mathematics identity and dispositions. Existing literature suggests that the practices teachers implement in the classroom significantly shape students' emerging mathematical identities and dispositions, and the sense of competence students feel as learners (Boaler & Greeno, 2002; Horn, 2008). Most recently, Gutierrez (2013) has compelling argued that all mathematics teachers implicitly and explicitly function as *identity workers* because "they contribute to the identities students construct as well as constantly reproduce what mathematics is and how people might relate to it (or not)" (p. 11). The political dimension of care recognizes that the relationship between learning and identity is bi-directional, specifically "with access to learning supporting stronger identities, and identity, in turn, supporting learning" (Nasir & McKinney de Royston, 2013, p. 264) and that identity is influenced by "what is made available to individuals in the various social and cultural communities they inhabit and how they enact their participation across them" (DiME, 2007, p. 409).

Caring with awareness. Recent work by Bartell (2011) begins to move the field towards a crystallized vision of what it might mean for mathematics teachers to care for students while attending to issues of identity and power through their instruction. She explicates that teachers who *care with awareness* "know their students well mathematically, racially, culturally, and politically" (p. 65) and use this knowledge to create learning opportunities that support equitable classroom participation. Specifically, teachers build authentic and respectful relationships with their students by confirming who they are, working to "confront unequal power relations *within* their classrooms" (p. 63, emphasis in original) by assigning competence to the mathematical contributions of "lower status" students, and explicitly reject deficit-based narratives associated with students of color. Importantly, building academically strong relationships with students means teachers hold high academic expectations for their students and provide them with an "academically rigorous and liberatory, self-empowering education" (p. 65).

Taken together, the political dimension of care reveals that caring for students in authentic ways (Valenzuela, 1999) is inextricably related to issues of race, culture, and power, or more specifically "the *ethical* use of power" (Noblit, 1993, p. 24, emphasis added).

Summary

In sum, students and teachers build pedagogical relationships in mathematics classrooms although the three dimensions of personal, mathematical, and political care. Although they have been presented separately, the dimensions of care in this framework overlap and underscore one another. For example, caring for students personally suggests getting to know them as individual persons and so in one sense, provides insight into the socio-emotional ways students might respond to a mathematics task and supports a teacher knowing how to facilitate the task in ways that make it more likely for them to engage which can also be viewed as an aspect of mathematical care. Mathematical care relies on political care because an equitable conception of what it means to do and learn mathematics influences what counts as "knowing" mathematics and has implications for whose knowledge and ideas are positioned as relevant in the classroom. The dimension of political care recognizes that students from non-dominant groups possess valuable knowledge that may be different from the dominant school culture, and caring for students politically requires getting to know individual students' racial, ethnic, and cultural backgrounds and experiences (i.e., a form of personal caring), and facilitating activities in ways that provide students access to key ideas (i.e., a form of mathematical caring).

Finally, and perhaps most importantly, forming productive student-teacher relationships along the three dimensions of personal, mathematical, and political care compels a teacher to engage in a continuous "process of ongoing reflection and negotiation of meaning amid various socio-cultural, institutional and discursive contexts" (Hauver-James, 2012, p. 167) and remain mindful of the implications of her pedagogical actions in the classroom (Bartell, 2011).

Looking forward, the theoretical framework of ICA serves as the foundational basis for the design of the classroom-based intervention that the remainder of this dissertation focuses on. As I attempted to demonstrate in this paper, a fundamental complexity in building pedagogical relationships with students is that this process cannot be entirely predetermined and is largely influenced by the individual student, who the teacher sees the student as, what she thinks is important for the student to know and do, and the context in which the relationship develops. To develop our ideas about how students and teachers build pedagogical relationships in mathematical classrooms further, designing and implementing an instructional intervention that examines how ICA works in practice is an important next step.

At the beginning of this chapter, I discussed Cook and Brown's (1999) ideas of explicit and tacit knowledge to specify the difference between my conceptualization of *care* and *caring* in this study. Recall, therefore, that knowledge of care is essential, but insufficient for the actual interactive work of building relationships with students in the classroom. Therefore, linking the framework of ICA with what happens as a teacher attempts to enact her mathematics practice in "real-time" provides a nuanced view of how teachers establish and maintain relationships with their students in the classroom and how caring potentially serves as a mechanism to enable student learning.

Above all, "relational work requires both thought and action" (Lampert, 2010, p. 31). Therefore, I investigate the "action" aspect of the relational work of establishing and maintaining pedagogical relationships in the remaining analytic chapters in this dissertation. In the next chapter, I describe the intervention study and related methodology and methods employed in the empirical line of inquiry.

CHAPTER 4: RESEARCH DESIGN AND METHODS

This study was designed to examine the practical and theoretical implications of taking an *integrated caring approach* (ICA) to mathematics instruction and investigate how this approach supported student mathematics learning and enabled the development of caring pedagogical relationships. In Chapter 3, I described the three dimensions of care – personal, mathematical, and political – involved in the theoretical framework of ICA. In this chapter, I describe the methodological and design choices of this study, and illustrate how the framework of ICA guided the design and implementation of the classroom-based intervention that serves as the context for the empirical line of inquiry for the subsequent analytic chapters.

This chapter is split into four sections. I begin by providing my rationale for the two methodologies that undergirded my overarching research design. In the second section, I describe my classroom-based intervention with one class of fourth grade students and explain my positionality as the teacher-researcher in this study, including my previous experiences in the school district and the ethical issues I grappled with. I discuss the broader school context and then move inside the walls of our fourth grade classroom to introduce the fourth-grade class and teacher intern who are a part of this study. I also describe my instructional approach and the design-research cycle that shaped my mathematics teaching. I outline my data collection methods in the third section and close the chapter with a description and overview of my analytic methods.

Methodology

To meet the goals of this research, I drew on both practitioner inquiry (Cochran-Smith & Lytle, 1993) and design-based research (Cobb, Stephan, McClain, &

Gravemeijer, 2001; Cobb, Confrey, DiSessa, Lehrer, & Schaubel, 2003; Cobb, Gresalfi, & Hodge, 2009; Styliandes & Styliandes, 2013). The blend of these two methodologies provided me with a unique lens in which to examine and experience the process of building student-teacher relationships through the teaching and learning of mathematics.

Practitioner Inquiry: Experiencing a particular practice

The overarching aim of this research was to understand the process of building productive student-teacher relationships in the context of mathematics practice. Recall that establishing this relationship requires the one-caring teacher and cared-for student interact in particular ways; specifically, the processes of *engrossment* and *motivational displacement* are critical, and the caring encounter begins when the teacher "take[s] on the other's reality as possibility and begin[s] to feel its reality…[then] must act accordingly" (Noddings, 1984, p. 16). Therefore, it was important for me not only to investigate how these relationships form but also to experience this firsthand – both intellectually and emotionally – from the perspective of the teacher striving to be *in relation* with her students. In other words, it was critical that I understand the process as the teacher-researcher working "from the inside" (Ball, 2000).

Cochran-Smith and Lytle (1993) describe practitioner research as systematic and intentional inquiry that involves the identification of a practical issue, examining the relevant contexts in which the problem is situated, planning and enacting a course of action, and generating various forms of data for analysis and triangulation. As they argue, this methodology constitutes "a different epistemology that regards inquiry by teachers themselves as a distinctive and important way of knowing about teaching" (p. 43). Specific to mathematics education, Ball's (2000) conception of first-person inquiry also privileges the importance of investigating problems in practice. In particular, teacher-researchers:

> Design a mathematical terrain or course, try to work with a group of students in pursuit of its goals, and examine carefully what it takes to manage that undertaking. What mathematical issues arise? What do students say and do, and what does this require of the teacher? (p. 373)

Investigating mathematics practice through the use of first-person inquiry provided a practical yet systematic research method with which to investigate an integrated caring approach. In addition, as Ball suggests, “analyses such as these can offer other illuminations of what teachers need to know to teach mathematics” (p. 373).

The use of practitioner inquiry, however, can be met with suspicion from some within the scholarly community (Anderson & Herr, 1999; Cochran-Smith & Lytle, 1990; Zeichner, 2009). Pointing to inherent differences in the nature of the work done by teachers and researchers, some suggest this type of research challenges the legitimacy of the scholarly perspective (Metz & Page, 2002). Others claim that existing epistemological tensions between school and university contexts lead teacher-researchers to confront and navigate “two very different institutional contexts [of] the public school and the university” (Labaree, 2003, p. 16).

A rival argument, however, explicitly seeks to turn on its head conventional notions of what counts as research, specifically arguing that the concerns outlined above drive the need for research conducted from an insider perspective (Ball, 2000; Lampert, 2001). Chiefly, if “the mission of the educational researcher is to make sense of the way schools work and the way they don’t” (Labaree, 2003, p. 17), situating oneself in the middle of this ostensibly messy space could lead to more fluid understandings of the interacting and dynamic relationship between theory and practice, and, in turn, how each body of knowledge informs and enables the other (see Cook & Brown, 1999). Seen from this hybrid perspective, teacher-research is not simply useful, but essential for illuminating new or unseen possibilities for supporting the work of classroom teachers. To lend credence to this point, insights gained from first-person inquiries (e.g., Ball, 1993; Lampert, 2001; Lubienski, 2000) have pressed the field of mathematics education forward by illustrating how practitioners manage problems that arise when one "confront[s] real students in the context of real lessons with real learning goals" (Stigler & Hiebert, 1999, p. 126).

Classroom-Based Design Research: Probing a particular practice

This study was also undertaken to examine a particular kind of practice and was influenced by the tenets of design-based research. I sought to understand how teachers build productive working relationships with their students in subject-specific ways, or *through* the process of teaching and learning mathematics. Therefore, drawing on design-based methodology for the purposes of pedagogical design complemented my goals.

Design-based research differs from other research traditions in that it seeks to *create* a phenomenon instead of investigating naturally occurring phenomena (Cobb et al., 2001; Cobb et al., 2003; Cobb et al., 2009; Styliandes & Styliandes, 2013). Instructional design and research are interrelated processes in design-based research, and a signifying feature of this methodology is its process-oriented focus, namely "the intent [is] to develop, test and refine theories, not merely to empirically tune 'what works'" (Cobb et al., 2009, p. 225). At its core, the design-research cycle is underscored by the notion of *intervention*, and researchers strive to unpack the black-box model of inputs and outputs. In particular, this methodology problematizes the "assumption that instructional approaches should be derived from theory in a top–down manner" (Cobb et al., 2001, p. 118) and embraces a reflexive and fluid relationship between practice and theory where neither is privileged over the other.

Classroom-based teaching interventions, in particular, seek to understand how instruction opens up or constrains the learning process for a collective group of students. Instruction, therefore, becomes the tool for investigation, and instructional design is purposefully exploited to develop working theories that support a systematic understanding of *how* learning occurs. Through repeated and iterative cycles of design, learning activities are continuously "engineered" to advance learning goals within the classroom context. From the interplay of monitoring student learning and ongoing analysis, researchers formulate, test, and refine conjectures through the repeated design and implementation of teaching "episodes" (Cobb et al., 2003; Cobb et al., 2009; Simon, 1995)

Researchers do not strive to make context-free generalizations in classroom-based studies, and context is seen as an integral and meaningful aspect of the phenomenon under investigation. In particular, a central research goal is to create and examine the development of productive classroom ecologies and understand how classroom conditions support or hinder student learning. Thus, conceptions of mathematics learning are often expanded in design-based study to include "learning-relevant social practices and even constructs such as identity and interest" (Cobb et al., 2003, p. 10).

A central aim of design studies is to produce pragmatic solutions to problems in practice *and* deepen theoretical understandings by studying phenomena in the context of real-world settings (Edelson, 2002; Styliandes & Styliandes, 2013). Thus, the final phase of the methodology involves conducting retrospective analyses of the generated data upon completion of the intervention. This "post-hoc" analysis is done for the purposes of constructing explanatory models that aim to provide an account for the learning progression in the classroom, thereby situating the phenomenon under investigation in a broader theoretical classification (Cobb et al., 2003; Cobb et al., 2009).

My Classroom-Based Teaching Intervention

In the section below, I provide an overview of the teaching intervention and describe the mathematical activities the students and I engaged with in the classroom throughout the 12-week intervention. To examine the possibilities of approaching mathematics teaching and learning from the theoretical model of an integrated caring approach (ICA) to mathematics practice, I took up the role of teacher-researcher and taught a class of fourth grade students in one public K-6 elementary school in Northern California. The 12-week intervention began at the end of November 2012 and lasted until early March 2013.

As the teacher-researcher, I intentionally aimed to influence students' mathematics learning through the design of my lessons and mathematical activities, and the theoretical model of ICA influenced the design of the intervention. Specifically, I theorized that teachers build productive working relationships with their students along the three interdependent dimensions of mathematical, personal, and political care. Recall that to begin the process of establishing caring pedagogical relationships, a teacher enacts care for her students by presenting mathematical activities, and attends and responds to students through caring interactions that aim to enable students' engagement and participation. The student affirms the teacher's care by "being open to the teacher's interventions" (Hackenberg, 2005b, p. 2) and taking up these mathematics opportunities to learn, which supports the formation the caring pedagogical relationship. The theoretical underpinnings of the intervention were a starting place to guide my actions in the classroom and a lens to support me in making sense of my practice and classroom interactions with the fourth grade students.

Study Participants

Teacher-researcher positionality. I am a Chinese-American, middle-class female, and I served as the teacher-researcher in this study. This research took place in the school district where I taught elementary school for nine years before becoming a full-time graduate student[2]. My work as a former elementary teacher and the prior relationships I developed in this district provided tremendous advantage in gaining access and support for this study. The principal of Oakwood School, the site of this study, was a former colleague of mine. We taught together at another school in the district for four years before she took her current administrative position. The district superintendent had been a principal at a different school in the district before assuming his current position. Although we had not worked together in a principal-teacher capacity, we had interacted over the years because of my involvement with district-wide committees and my role as a teacher mentor for beginning teachers in the district. In Fall 2012, Oakwood's principal offered me a teaching position as a long-term "guest" teacher for a fourth grade teacher who would be on leave for one trimester. I inquired about using the classroom as a site for my research, and both the principal and superintendent willingly provided support for my research, as did the official teacher of record whose class I taught.

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[2] I expand on my past experiences as an elementary school teacher in this district in Chapter 1.

The focus of this research was specifically in the area of mathematics, however, I was hired as a full-time elementary teacher. Therefore, I assumed the same responsibilities as other "regular" teachers and taught all subjects within the elementary school curriculum (e.g., mathematics, literacy, writing, science, social studies, and physical education). There were unique affordances and constraints associated with serving as a full-time teacher who was, in some sense, researching only part of her teaching. I outline these advantages and disadvantages below.

On the one hand, my research responsibilities of data collection and designing, planning, and refining lessons added to my substantial workload as a classroom teacher. This could lead to criticisms that my research was perhaps less "mathematical" or "rigorous" because of my full teaching load and my split foci with other disciplinary areas. There is likely some truth to these criticisms. On the other hand, I did not consider my work as a researcher as distinctly separate from my work as teacher. Similar to the philosophical assumptions of design-based research, I saw mutually reinforcing affordances between theory and practice. The research skills I had developed over the past four years of "learning to look, listen, respond, not assume, watch, entertain differences, and suspend belief (or disbelief) [enhanced my] capacity to act on my teacherly commitments to be moral, to hear and respect my students, [and] to understand my own limitations" (Wilson, 1995, p. 21). My daily iterative cycles of analysis and refinement also ran parallel to the work of teaching (albeit in a more intensified form).

I argue, however, that my teaching the children in multiple subjects while researching a single subject should not be viewed purely as a limitation. Instead, my teaching experiences in this study provide a glimpse into the experiences of most elementary teachers who, as generalists, strive for ambitious student outcomes in mathematics while simultaneously working to bring forth ambitious outcomes in other subjects as well (see Spillane, 2000). Spotlighting the multiple disciplinary commitments elementary teachers balance in their day-to-day work forefronts the broader interdisciplinary context in which elementary mathematics is situated, a unique space often underexplored in mathematics education research.

For these reasons, although this study represents a small attempt to contribute to the efforts of teacher-researchers who have documented their experiences teaching mathematics as single-subject elementary teachers (e.g., Ball, 1993; Heaton, 2000; Lampert, 2001), I also situate my work in a slightly different space. I make this distinction to highlight the fact that, in this study, the students and I were interacting – in disciplinary and social ways – throughout the entire school day, above and beyond the 80 minute time period set aside for learning mathematics. The interdisciplinary context and the extended time period in which we interacted necessarily shaped the lens in which I viewed the students, the mathematics, and my related classroom analyses.

Of significance to this study, serving as the full-time teacher afforded me the opportunity to spend more time interacting with and, by implication, developing stronger relationships with the fourth grade class. I learned that in order to understand and enhance students' mathematical experiences, I also needed to get to know them in "non-mathematical" ways and learn about the social relationships among the children in the classroom. Student-teacher interactions on the playground or in the classroom outside of formal learning time mattered as well. In some sense, it was impossible to bound the scope of my inquiry within the margins of the teaching and learning of mathematics. To borrow Lampert's (2000) words, "from a practitioner's perspective, the boundaries among the [areas are] somewhat puzzling" (p. 87), and aspects of my investigation overlapped and merged with other disciplinary areas and social spaces during the intervention. Therefore, while mathematics is at the core of this study, I speak to and reveal traces of the interdisciplinary and interwoven nature of my analysis throughout the remainder of this dissertation, but particularly in the discussion on my instructional practices in Chapter 6[3].

Because of my long-standing connections with the district and community, I started my inquiry with substantial knowledge of the context in which I would be conducting this study. I am cognizant my personal experiences shaped my perspective, and the ways I interpreted "the immediate and local meanings of actions" (Erickson, 1986, p. 119). Anderson, Herr, and Nihlen (1994) explain that:

> …academics (outsiders) want to understand what it is like to be an insider without 'going native' and losing the outsider's perspective. Practitioners (insiders) already know what it is like to be an insider, but because they are 'native' to the setting, they must work to see the taken-for-granted aspects of their practice from an outsider's perspective. (p. 27).

From my perspective, I believe I straddled both the "insider" and "outsider" line. On the one hand, being a former teacher of the district granted me insider status and intimate local knowledge, and afforded me "an unusual degree of access to 'insider' meanings and practice" (Horn & Little, 2010, p. 187). I was by no means a neutral or disinterested researcher, and I felt, and still feel, a sense of gratitude towards those individuals who granted me latitude and made it possible for me to carry out a study that will lead to the completion of my degree.

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[3] I describe how I accomplished this analytically in the data and methods section in Chapter 6.

On the other hand, being away from the district and fully immersed in the world of research for several years prior to the start of the study also provided me with a distanced view of the district. The literature and theories I had studied and ruminated over during my coursework as a doctoral student provided me with a new perspective and came to bear on the ways I interpreted my school and classroom experiences. I did not anticipate I would feel like an outsider as often as I did. For example, I was sensitive to the normative school discourse used to describe students (e.g., "far below basic", "limited English proficient", "underperforming"), and recognized that these narratives enabled structural hierarchies and influenced "how people talk and think about schooling; what knowledge, values, and behaviors are considered legitimate, and how educators see their students and their responsibilities to them" (Lipman, 2004, p. 15). But this institutional language of school seemed to be a "taken-as-shared" way of talking, and I sometimes felt lonely while teaching and wished there was someone at the school with whom I could discuss my thoughts.

Peshkin (1988) argues for the importance for researchers to attend to "the subjective underbrush of our own research experience" (p. 20), and I engaged in several activities during the intervention in an attempt to adopt a reflexive stance during the intervention and identify how my subjectivity potentially impacted my work. For example, my teacher reflective journal was a space for me to keep track of my emotional reactions, preconceptions, and assumptions. I engaged in phone conversations with another graduate student approximately twice a month, which also provided me with opportunities to discuss my experiences with an "objective" outsider. Finally, I adopted a perspective of "being alongside" (Rowling, 1999), that is, developing a sense of empathy and “feeling” with those within the school and broader community, including parents, teachers, staff members, and administrators (who were all, in my view, stretched to the limit in terms of time and energy) while attempting to maintain a disciplined sense of difference.

Student participants. There were 34 students in the fourth grade class I taught, 14 females and 20 males. Of the 34 students, ten children were identified as Latino, ten as White, eight Asian-American, four as African American, and two students were identified as biracial (African American and Latino). 14 students were designated as English language learners, and the variety of languages spoken among the children (i.e., Spanish, Hmong, Hindi, Russian, and Samoan) reflected the rich diversity of our classroom. According to students’ scores on the California English Language Development Test (CELDT), three students were categorized as being in the early to beginning phases of their English language development, six in the intermediate phase, five students were designated as early advanced to advanced proficiency. Two students had individualized education plans (IEPs), and they received math and reading instruction daily from the special education teacher at the school.

Although the California Education Code states that class sizes in grades four through eight should not exceed 30, the district was struggling with student over-enrollment that year. The fourth grade was particularly impacted across the district, therefore all classes in this grade level had over 30 students. The experience of transitioning from a class size of 20 in lower elementary grades to over 30 students was difficult for many students in the classroom. As will become apparent later on, the class size of 34 is an important contextual feature in this study that shaped my classroom practices and students' classroom experiences.

Teacher intern. A teacher intern from the local university elementary teacher education program was also working in the fourth grade classroom. Julie was a White female and she had been the intern in the classroom since the beginning of the school year. Thus, I also served in the role of teacher-mentor during my time as teacher-researcher. Although Julie shared in many of the classroom teaching responsibilities, I was the primary mathematics instructor during the intervention. This decision was supported by both Julie and her teacher education supervisor prior to the start of my teaching. For the first 3 weeks of the intervention, Julie spent two days in the classroom each week and for the remainder of the trimester, she worked in the classroom four to five days a week.

Because she was present during the majority of my mathematics instruction, Julie was an important part of the day-to-day experiences of the children and me. Rather unintentionally, she became a "critical friend" (Bass, Anderson-Patton, & Allender, 2002), and another pair of eyes observing my lessons and providing feedback. She frequently took notes during my instruction and circulated the room and interacted with individual children during the lesson. Our regular debriefings over lunch were valuable to my research in a number of ways. Julie's observations and thoughts complemented or provided an alternative way of thinking about classroom incidents, and her questions forced me to articulate moment-to-moment or implicit decisions I had made during instruction. We discussed what we noticed happening, which students were engaging or not, and brainstormed possible solutions. As Bass et al. explain, "critical friends get to know each other's reactive points and blind spots, and hopefully learn when to support and when to challenge" (p. 67). Julie’s perspective forced me to continually question my assumptions and interpretations and ultimately strengthened my on-going analysis and conjectures.

I found Julie to be a particularly observant, sensitive, and reflective beginning teacher (a view Mrs. O and her teacher education supervisor both shared with me on separate occasions). I valued her feedback, yet I am aware that she may have felt inhibited from speaking freely to me due to the power imbalance that exists in most mentor-intern relationships. From my perspective, however, our relationship was not typical due to the uniqueness of our situation. I thought of and positioned Julie as a partner teacher more often than a student teacher. Because she had been working in the school and classroom since the beginning of the school year, her previous experiences were a resource for me to draw on. Julie was there to witness the ups and downs of the intervention, and I felt foolish and vulnerable teaching in front of her at times. Although I believed (or rather hoped!) my instruction provided a model of the inherent uncertainty of teaching and the dilemmas teachers face in their work (Lampert, 2001), I couldn’t help but wonder if she sometimes wished for a more competent mentor teacher.

I appreciated Julie’s professionalism and flexibility in the face of a non-traditional student teaching experience, and her generosity in providing feedback on my mathematics teaching. I was also aware that my “hogging” of the mathematics teaching was an imposition on her development as a teacher. Our partnership, however, appeared to benefit her as well. Julie shared that having the opportunity to observe my mathematics teaching was useful for her because she felt it aligned more closely with the practices discussed in her coursework. After the conclusion of the teaching intervention, I wrote letters of recommendation on her behalf for potential teaching positions, and after she was offered a teaching position as a middle school mathematics teacher, we spent several occasions planning lessons over the summer prior to the start of her first year teaching.

Research Context

School context. Oakwood School was located in the River Park School District, a small school district located outside the metropolitan area of the city. The school was located in a semi-industrial neighborhood that housed several large warehouses. Most students did not live within walking distance of the school. The school provided extensive bus service for students, and those students who did not ride the bus lived primarily in a mobile home park next to the school. The school was located in a socio-economically disadvantaged neighborhood, and over 92% of the students in the school qualified for free or reduced lunch according to the federal subsidized lunch program.

Oakwood served a racially, ethnically, culturally, and linguistically diverse student population. According to 2011-2012 data obtained from the California Department of Education (CDE, 2012), 40% of the student population was identified as Latino, 25% Asian, 18% White, 12% American Indian, Pacific Islander, or Filipino, 11% African-American, and 3% were identified as biracial. Approximately 45% of students in the school were classified as English language learners. The mobility rate of the student population was high, and students would frequently move in and out of the school, either between schools within the district or to/from a neighboring school district. This phenomenon was also visible in our fourth grade classroom. During the 12-weeks of the intervention, 4 students moved in and out of the classroom.

Oakwood had been labeled a “Program Improvement” (PI) school for not meeting its federal Adequate Yearly Progress (AYP) goals on the end-of-year California Standardized Tests (CST). The school was in its final year of PI status the year I taught. Because Oakwood would be exited out of PI status if the school met or exceeded their AYP scores on the CST that year, student performance on the end-of-the-year test was particularly important that year. Most all of the school staff meetings I attended were centered on brainstorming and developing school-wide and classroom practices that would support students in reaching these goals.

District context. Oakwood was located in a test-driven district context (Valli, Croninger, Chambliss, Graeber, & Buese, 2008), which influenced the instructional decisions of the teachers at the school, including myself, which is an issue that will emerge throughout the analytic chapters. To provide necessary context, during the 2012-2013 school year, River Park was in the first year of promoting a district-wide initiative centered on promoting teacher’s use of “data-driven instructional decision making” in all areas of the curriculum. As such, the district had adopted a computerized data management system and assessment system called *Illuminate*. *Illuminate* housed a variety of student data ranging from student attendance, English language learner status, and performance outcomes on a range of formative and summative assessments. The overarching notion was that teachers could use the generated data reports to improve their classroom instruction and student outcomes.

Interim student benchmark assessments were created to support teachers in tracking student progress across the school year, and assessment items were aligned with the curricular topics students would encounter on the end of the year California State Test

(CST). Students were given two separate benchmarks, one in language arts and mathematics, every six weeks. With particular respect to the mathematics benchmarks, the assessment consisted of 45-50 multiple choice questions, and students were primarily tested on their procedural knowledge in mathematics. Upon benchmark completion, teachers scanned student answer sheets into the computerized system from their classroom. Class reports of student performance could be generated immediately, and the resulting data could be aggregated and manipulated in multiple ways.

Teachers were required to upload and report students' assessment scores to the district administrators through the *Illuminate* system by a specific date. Therefore, although the district did not have an official pacing guide, the two-week benchmark window served as an unofficial proxy. Because teachers were provided with a copy of the benchmarks ahead of time, teachers in the school used the benchmark topics as indicators of what content to cover during the 6 weeks of instructional time leading up to the test administration, specifically by backtracking from the specific date benchmark scores were due to district administrators. The benchmark test and curricular pacing were frequent agenda items during our grade-level collaborative meetings. Mrs. O, the teacher of record, also explained to me that it was difficult for benchmarks to be completed within a single lesson due to the large number of tested items, and she advised me to administer the test across a two-day time period.

Classroom configuration. Room 7 was a typical four-walled elementary school classroom. Green bulletin boards with decorative borders held examples of student work, classroom jobs, and upcoming school activities. Brightly colored posters with inspirational quotes were posted on the back wall. A Promethean ActivBoard was located in the middle of the front wall of the classroom. The teacher's desk was in the front right corner and ceiling to floor length cupboards were located in the opposite corner. A whiteboard was also present along an adjacent wall of the classroom, and the bottom half of the wall directly across from the whiteboard housed a class library that was overflowing with paperback chapter books.

A row of six rectangular windows adorned the top half of the wall above the library. On many days, the California sunshine streamed through the windows, filling the classroom with light and warmth. Blue carpeting covered the majority of the classroom floor, however, large square tiles alternating between the colors of white, tan, and brown lay on the back floor of the classroom. A kidney shaped table with five surrounding chairs, the classroom faucet and sink, and four student computers were all located in this back area.

There were 36 of us in the class in total, 34 students and two teachers. When I was alone in the classroom before and after school, the classroom felt open and spacious. But when it was filled with chattering children, their bulky coats and sweatshirts, backpacks, pencil boxes, and ever present knickknacks, the room took on a different and at times uncomfortably confining feel. The space was not designed to hold so many people or the additional furniture placed in the room to accommodate all of us. There were 16 "two-seater" desks in which pairs of students shared one large desktop yet had individual desk space below. There were also two single desks in the room.

Prior to the intervention, I spent two full days in the classroom getting to know the students, observing Mrs. O teaching the students, and developing a sense of the classroom dynamics. During these visits, the desks were arranged in large groups that resembled the letter “E”. I noticed that it was not possible for all 34 desks to fit on the carpeted area. Some desks had spilled over onto the tiled portion in the back of the classroom, a blurred line of demarcation that served as a sharp reminder of the lack of physical space in the classroom. As a participant observer on those two days, I seated myself next to one student, Colin, who was sitting in a single desk near the back of the classroom on the tiled portion of the floor. It was difficult for me to see the Promethean Board or hear what was being discussed in the front of the classroom from my position next to him. Wondering if it was perhaps just a case of “old” eyes and ears, I asked if he could see or hear what was being said, and he shook his head to indicate no.

One of my first tasks at the start of the intervention, therefore, was to figure out a way to arrange all student desks to fit on the blue carpet so that those seated in the back of the classroom could see and hear more clearly. My original intention of arranging desks in a large U-shape to facilitate classroom discussions prior to seeing the classroom was no longer possible due to space constraints. It was challenging to arrange the desks in group configurations in such a way that all desks fit on the carpeted portion, all group members could see yet still retain a semblance of personal space, and everyone could move about safely in the classroom. For my first attempt, it required arranging some desks in small and large L-shaped groups, others in short traditional rows, with remaining two-seater desks scattered and situated at an angle in the remaining unfilled spaces.

Situating all the desks on the carpet, however, meant there was little room available for the students and me to move about freely in the classroom. Without question, it was challenging for all of us to be up and around at the same time. It was nearly impossible for me to move about the classroom without bumping into something or someone, tripping over a jacket that had fallen off the back of a chair, or slipping on a renegade pencil that had rolled on the floor. Like Spiderman, I became adept at maneuvering quickly and fluidly over and through tight spaces. The children became accustomed to scooting their chairs all the way in until their chests touched the edge of their desks to allow others to sidle by behind them. Lacie, a particularly expressive girl, would dramatically suck in her breath each time she did this because, as she helpfully explained, “air takes up a lot of space”.

When teaching, I found myself stationed in the front or back of the room more often than I wished simply because there was no direct pathway between children’s desks once they were seated and chairs were no longer pushed underneath the desks as they usually were when the student were not in the room. In my teacher reflective journal, I expressed frustration with the lack of classroom space on multiple occasions (November 27, November 28, December 4, December 7) noting that the inability for free movement in the classroom constrained the kinds of participatory structures for which I strived.

Throughout the intervention, I moved and organized students’ desks multiple times in an attempt to create a classroom space that would promote the “feel” of a learning community and facilitate student engagement and participation in classroom activities. Documentation from my reflective journal reveals that, not counting the times I moved individual student desks around, student desks were moved into different class configurations a total of 5 times over the 12 weeks.

Implementation of an Integrated Caring Approach

The integrated caring framework informed my pedagogical choices in both the planning and implementation stages, and I share these choices in the section below. But before I do, recall that the dimensions of mathematical, personal, and political care are interconnected and mutually reinforcing in the framework of an integrated caring approach. Parsing out the dimensions in a lesson-planning framework is somewhat in tension with its interwoven nature, still it was necessary to do so. The planning framework served as a pedagogical tool and provided a conceptual infrastructure for guiding and making sense of my choices and actions as I planned and implemented lessons. Analogous to the arguments made for the importance of decomposing practice for the purposes of making it learnable, the three dimensions in this framework also provides a "common technical vocabulary" (Grossman & McDonald, 2008, p. 186) with which to characterize the work of building pedagogical relationships and enhances our understanding of the particular ways each dimension contributed to the development of student-teacher relationships in the process of teaching mathematics.

The curriculum. It was important for me to respect the institutional boundary of the school by continuing to use the district-mandated curriculum and teaching the math topics in the sequence Mrs. O and her grade level partner had set. The district used a state-adopted, mathematics program called *envisionMATH* (2009) that aligned with the curriculum focal points suggested by NCTM (2000) standards and the California state standards. The intended goals of the curriculum were "centered around interactive and visual learning and differentiated instruction to address the specific needs of all students" (p. xxi). The curriculum was organized around 20 mathematical topics, and each topic focused on a particular content strand. Lessons organized under each topic were aimed to address key aspects of each mathematical topic.

By way of example, the focus of Topic 8 was “Dividing by 1-digit divisors” and related lessons included “Using Mental Math to Divide”, “Connecting Models and Symbols”, “Dividing with Remainders”, and “Deciding Where to Start Dividing”. The number of lessons within each topic ranged from between four to twelve lessons and following the completion of each mathematical topic, students were given a performance assessment to measure their progress. Teachers had the option of choosing between one of two assessments; a multiple choice assessment consisting of between 30-35 multiple choice questions focused mainly on procedural competence or a 12-15 “short answer” assessment with short “word problems”.

According to the curriculum design, the format of each lesson progressed through three main components: the first part, the “Interactive Learning” (IL) activity was a “problem-based” introductory activity to the lesson, followed by guided problem sets, and closing with independent student practice. In my two observations of her math lessons prior to the intervention, Mrs. O’s lessons followed the three component model outlined by the curriculum, however, she substituted the IL activity with “Daily Spiral Review[4]” (DSR). Mrs. O explained that she began most of her lessons with DSR because, in her experience, the IL activity took longer than the 15-20 minute time frame suggested by the curriculum. She also found that the tasks presented in the ILs were often too challenging for the students.

Structure of mathematics lessons. I taught mathematics each day for approximately 80 minutes. The structure of my lessons followed the three part routine

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[4] Daily spiral review was also a part of the curriculum. It consisted of between 8-10 multiple choice questions related to content students had learned in previous lessons. Teachers were given the option of beginning the lesson with the spiral review or the IL according to the curriculum suggestions.

outlined above, however, I chose to begin lessons with the IL instead of the DSR. The dimension of mathematical care aims to support students in conceptualizing mathematics as a process of sense-making and reasoning, and the IL activity presented me with the greatest opportunity to approach mathematics instruction through an integrated caring approach. The structure of the IL loosely resembled the three phases of a standards-based lesson: posing of a mathematical task, students working on solving the task, and teacher orchestrates a whole-class discussion where student mathematical strategies are presented and discussed (Van de Walle, Folk, Karp, & Bay-Williams, 2010). Instead of the 15-20 minutes suggested by the curriculum, I extended the IL to 45 minutes and shortened the amount of time for guided and independent practice. I closed each day's lesson with a small wrap up discussion and provided time for students to write in their mathematics journal twice a week. I also continued to administer a 5 minute timed math fact test to students as they were used to.

Prior to the start of a mathematical topic, I conducted an analysis of all lessons within that topic. Based on the mathematical objectives, I considered ways to reorganize the lesson sequence or combine lessons in ways that would support students in making stronger connections between mathematical concepts in order to strengthen their overall understandings. Using Topic 8 as an example again, I did not teach the lesson of *Connecting Models and Symbols* separately from the other lessons (e.g., *Dividing by 1-digit divisors* or *Dividing with Remainders*) as suggested by the curriculum. Instead, by embedding the practice of mathematical modeling in the content learning of division, I aimed to provide opportunities for students to make connections between models and symbols and division. Analyzing the curriculum from a disciplinary point of view supported me in establishing lessons that would meet the goals of ICA, and I associate pedagogical choices such as these with the dimension of mathematical care.

Because I chose to begin lessons using the IL instead of DSR, aspects of my instruction were likely novel for students. Gravemeijer and Cobb (2006) explain that in design-based research, to "develop a conjectured local instructional theory, one has to consider the instructional starting points" (p. 51) or the prior instruction students were engaging with before the start of the intervention. I hypothesize that many of the students had experienced primarily traditional modes of instruction prior to the intervention. During the two lessons I observed in Mrs. O's class prior to the start of my teaching, Mrs. O and the students worked on problem sets together as a class, she called on students to share their answers with the class and tended to be the one to validate the correctness of students' answer choices. I reference the type of mathematics instruction I assume the fourth-grade students were engaging with prior to the intervention to make the point that students were asked to engage with relatively new mathematical practices during the intervention. That is, establishing new social and mathematical norms and expanding the fourth-grade students' repertoire of learning practices (Boaler, 2002; Cohen & Ball, 2001) became an important part of the work during the intervention.

Lesson planning. I created a lesson planning framework that reflected the three dimensions of care as a structure to design the lesson (See Appendix A), particularly the IL portion. Broadly speaking, to connect with the dimensions of mathematical and political care, activities and participatory structures were aligned with the theoretical principles of ambitious and equitable mathematics practice, respectively (Bartell, 2001; Jackson & Cobb, 2010). Instructional practices that attended to and monitored student affect and socio-emotional responses (Hackenberg, 2010; Rosiek, 2003; Rosiek & Beghetto, 2009) supported me in operationalizing the personal dimension of care in my lessons.

Connecting to the dimension of mathematical care, I aimed to support students in learning key mathematical ideas by providing them with opportunities to engage in the process of mathematical sense-making. Therefore, the instructional tasks I chose to use during the IL were purposeful. I examined the given "Problem of the Day" in each textbook lesson to see if the task aligned with the mathematical concepts and objectives of the lesson, involved an important mathematical concept, or engaged students in learning mathematics through problem-solving. If the provided task did not appear to suffice, I substituted tasks using outside resources I had gained from my experiences as an elementary math methods instructor (See Appendix B for a partial list of tasks).

My task selection was also motivated by the dimension of personal care, and the desire to "share a common reference point" (Rogoff, 1986, p. 32) and initiate a connection with students through the process of teaching and learning mathematics. Tasks were therefore chosen with an eye towards "harmoniz[ing]with students' current schemes and energetic responses to mathematical activity" (Hackenberg, 2010, p. 242) while also presenting students with opportunities for *productive* struggle, or "the process of thinking, making sense, and persevering in the face of not knowing exactly how to proceed or whether a particular approach will work" (Merseth, n.d, p. 2).

Specifically, I selected problem-solving tasks that met students where they were mathematically and provided opportunities for them to engage with key mathematical ideas and space to deeper understandings, all the while remaining aware that "challenges

[that] overwhelm students cognitively and motivationally also are likely to overpower them emotionally" (Turner & Meyer, 2004, p. 312). Yet, as Rosiek (2003) notes, "emotions…such as anger, sadness, or frustration can often function to focus students more closely on the subject matter being taught" (p. 407), therefore I did not shy away from presenting students with challenging tasks.

Rather, in alignment with an integrated caring approach, I theorized the key to sustaining student mathematical engagement involved an amalgam of presenting students with mathematically rich tasks (Bartell, 2011; Hackenberg, 2010; Jackson & Cobb, 2011), monitoring student affective and socio-emotional responses during task engagement (Hackenberg, 2010), and interacting with students in ways to alleviate potentially unconstructive emotional responses that would lead to *un*productive struggle, disengagement, or resistance (Rosiek, 2003).

I also made decorative and non-mathematical "tweaks" to some of the mathematical tasks, for example, by changing the names of the individuals in the problem to the names of students in the class. Other times, drawing on my developing knowledge of the students and the school community, I modified the original problem situation to a context that I perceived as familiar to students' experiences (e.g., using the school or classroom as a context, using the everyday context of dividing brownies or buying pencils at the student store, etc).

These choices reflected the personal dimension of care in my lesson planning, and I hypothesized that making tasks more familiar to students could potentially serve as a mechanism to facilitate student interest and engagement. To be clear, I am not claiming that substituting student names directly supported students in developing stronger mathematical understandings, however, it was an attempt to position students vis-à-vis mathematics in ways that could enable constructive emotional responses (Rosiek & Beghetto, 2003).

Micro-cycle of design and analysis. My lessons throughout the 12-week intervention followed the “plan, enact, reflect, and refine” cycle of design-based research, therefore my instructional approach was necessarily evolving. This “micro-cycle” of design and analysis that I followed during the intervention aligned with the iterative cycle of design based research. Importantly, it also reflected the theoretical commitments of ICA and was guided by a sense of responsiveness to the students both collectively and individually, and I was explicitly concerned with monitoring students’ socio-emotional responses to activities as indications of their mathematical engagement. As care theory suggests, pedagogical relationships emerge in the interactional space between student and teacher in the teaching and learning process (Goldstein, 1999; Hackenberg, 2010; Noddings, 1984), and I theorized that my understanding of the learning and engagement of the fourth grade class (including my capacity to support and increase engagement) would emerge among the interplay of lesson implementation, my growing knowledge of students, and our classroom interactions.

Therefore, as working hypotheses emerged from my on-going analyses and developing knowledge of students, I refined lessons as well as my interactions with students during mathematics activities. The modifications I made for subsequent lessons were made on the basis of my inferences and local conjectures about how students were thinking and responding mathematically, perceptions of whether and how students were (or were not) taking up the opportunities to learn I attempted to provide through ICA, and what might account for these reasons.

For example, as I will describe in Chapter 5, the insight I gained about students' early mathematical experiences in the classroom emerged from my on-going data analysis and became central in shifting the design of my classroom activities and interactions with students. As Cobb and colleagues (2001) explain, the purpose of on-going analyses is to make local hypotheses about student learning, then design and implement new tasks and activities for the subsequent lesson on the basis of these interpretations. In particular, the teacher "acts responsively and intuitively in learning to think like her students – in merging with the students' experiences to the extent that is possible" (Hackenberg, 2005a, p. 65).

Other teacher-researchers (e.g., Hackenberg, 2010; Simon, 1995) note that hypotheses of student mathematics learning can be inspired from a variety of resources: prior experiences with students, experiences with a similar group of students, or theoretical and empirical research. In short, "the design researcher may take ideas from whatever sources to construe an instructional sequence" (Gravemeijer & Cobb, 2006, p. 51). Thus, coupled with my overarching theoretical model of ICA, I drew on additional resources both within and outside the classroom to form on-going conjectures.

Moving between the cyclic processes of thought experiment and instructional experiment, I continually hypothesized about the tasks used to support student learning, as well as the instructional tools, discourse patterns and participatory structures of the lesson. This nuanced interplay guided the design of my evolving mathematical practices, and over time, I became more adept at designing and modifying lessons, formulating and testing conjectures, and revising my hypothetical learning trajectory[5] (Cobb et al., 2001) of the fourth grade class.

As a note of caution, the term "trajectory" is misleading if one assumes the progression and development of pedagogical relationships in the fourth grade classroom followed a clear, linear path during the intervention. In reality, the trajectory we took was analogous to the motions of a roller coaster ride; the work of building relationships through the teaching and learning of mathematics was unsteady, dynamic, and complex. This meant it was possible for our class to veer towards a well-functioning and engaged mathematical community then – on a lesson-to-lesson or moment-to-moment basis – alternately dip and become a disorganized, passive, or resistant group of learners.

To be sure, the students and I underwent growing pains as we mutually negotiated what it meant to participate and engage in learning mathematics, particularly during the early weeks of the intervention. The bumpiness and unpredictability of students' mathematical engagement and participation was unsettling, yet faltering occurrences often provided the most potential for generating solutions and fruitful ideas for refinement. To this point, the iterative cycle of design, analysis, and refinement was part of the study design from the outset, yet from the lens of teacher-researcher working from the inside, this process was also unmistakably "etched into my work…mostly as an act of survival" (Ball, 2000, p. 368) particularly during the early days of the intervention.

[5] Simon (1995) uses the term hypothetical learning trajectory in his work as well. His definition, however, is rooted in a particular constructivist perspective while Cobb's expanded conception considers social and contextual aspects of learning conception, including students' ways of engaging and participating in activity structures and related tools.

Ethical Considerations

I discussed earlier the ways in which my teaching obligations potentially constrained my research efforts when describing my teacher-researcher positionality. I now turn this issue on its head and focus on how my research potentially conflicted with my teaching. I had written about my ethical obligations as a teacher-researcher in my proposal and anticipated potential issues, yet it was not until after I began my work in the classroom that I experienced firsthand the conflicts that arise when one pursues teacher and researcher role simultaneously.

First, I made conscious attempts to prevent my research agenda from overshadowing my work as a teacher. I recognized that the district administrators had approached and hired me as a teacher not a researcher. I also felt a sense of gratitude to the students, families, the teacher whose classroom I was "borrowing", and administrators for not only supporting this study, but for trusting me to carry out my research responsibly and ethically. As such, I worked diligently to carry out all instructional and organizational aspects of my work to the best of my capacity. I spent a significant amount of time and energy studying, planning, and teaching other subject areas, working to provide students with a well-rounded educational experience and strong opportunities to learn in all subjects, not only mathematics. I attended bi-monthly faculty meetings and weekly grade level meetings, collaborated with other classroom teachers and specialists at the school, and took part in school and community functions beyond regular school hours.

In addition, I recognized that acting as the students' primary classroom teacher while also conducting research in the classroom presented potential conflicts of interest and granted me authoritative “power”. I was also responsible for assigning student grades at the end of the trimester. From my perspective, however, grading student work did not present a major conflict for me during the intervention. That is, the overarching goal of this research was to understand how ICA influenced my teaching practice, the ways this approach enabled the development of student-teacher relationships, and how this relationship could be leveraged to support student mathematics learning. Measuring student learning through student grades, thus, was not an aspect of this study. To guard against any unconscious feelings of bias, however, I waited to administer the post-intervention survey and conduct post-intervention interviews until after I had submitted students’ trimester grades.

I also did not want students or their families to feel pressured to participate or feel concerned that their children’s grades or classroom instruction would be adversely affected if they chose not to take part in the study. In an attempt to ease these pressures, I attended all parent conferences Mrs. O, the teacher of record, held with parents and guardians prior to the start of the teaching intervention. I used this as an opportunity to discuss my research study with students’ families in person and assure them that their child’s participation was voluntary. I did not yet have human subjects research approval at the time of the conferences, therefore, I did not provide consent forms at this meeting. I distributed student consent forms to students after approval was given during the second week of the intervention and attached a one-page letter that summarized the conversation I had with parents/guardians at the conference. This letter and the human subjects parental consent forms were also translated in Spanish and Hmong languages for students whose families were bilingual. Of the 34 students in the class, 28 students chose to participate in the study.

Finally, I acknowledge that social desirability is a complicated phenomenon present throughout this study. By this I mean that a central aspect of this study was to examine how I could leverage my relationships with students to advance their mathematics learning, yet not exploit these student-teacher connections in a self-serving manner that led students to feel uncomfortable or say pleasing things to make me feel good about myself as their teacher. As the children's teacher, I realized that I held a particular amount of social "power". I was aware that some students may have been eager to please me and that my role as their teacher influenced students' responses, particularly their responses to surveys, journals, and interviews. Students may also have felt reluctant to openly share their mathematics experiences, particularly if these experiences were negative or if they had criticisms about my teaching because, as the instructor, I was a part of their experience.

I struggled with this delicate issue, particularly with respect to students' post-intervention interviews. Gaining access to children's experiences were critical pieces of data that would support my emerging understanding of how to support their learning, and I reasoned that someone who had a strong rapport with students would be able to "dig out" information from them in ways that an outside interviewer could not. In addition, an outside interviewer did not have access to the mathematical experiences the children and I shared from our time together in the classroom. I thought carefully when deciding whether to conduct interviews with the students myself or have Julie conduct them. I certainly did not want students to feel uncomfortable answering particular questions.

In the end, after consulting with my dissertation advisor, I chose to hold the interviews with the children myself. My reasoning was that the content and process of my individual interviews was not much different from the ways the students and I interacted in the classroom with one another. From the start, I had framed student feedback on surveys and journal entries as opportunities for me to learn from them, clarifying that I was interested in their experiences and not seeking a specific answer. And in their surveys, journals, and initial interviews, students were often forthright about the aspects of mathematics instruction they did or did not appreciate. Therefore, over the course of the 12 weeks, from my perspective, the students and I had established a pattern of interacting with one another, both in the context of whole class discussions or individual conversations, through the process of open dialogue (Noddings, 1984) in regards to issues that were occurring both within and beyond mathematics.

In sum, managing ethical, moral, and intellectual choices was a central and interwoven tension present during my time as teacher-researcher. While I entered the classroom with a research goal of understanding students' mathematical experiences, I saw my first priority as respecting students' feelings and boundaries. I can never be certain whether all students felt comfortable expressing their thoughts, and even though I strived to exercise self-awareness throughout the intervention, I do not claim I made the "right" choice at all times. I feel confident, however, in stating that I attempted to exercise my professional judgment to the best of my ability. I made every effort possible to keep the best interests of the students at the forefront of my decisions and strived to ensure that my personal interests and agenda as a researcher did not overshadow my work as a teacher.

Data Collection and Sources

I collected multiple kinds of data to document my implementation/enactment of ICA and to examine whether and how ICA shaped students' mathematical experiences in the classroom. As Ball (2000) also advises, it is important in first-person research studies "to collect data that allows the researcher to gain alternative perspectives and interpretations of his/her actions" (p. 375). My data set included a daily teacher reflective journal, lesson plans and other teacher materials, audio-recordings of lessons, student surveys, student journal entries, related classwork, and audio-recorded student interviews conducted before and after the intervention.

Teacher-Researcher Data

I collected four types of teacher-researcher data: a teacher reflective journal, audio-recordings of lessons, lesson plans, and materials and artifacts generated during each lesson. To "capture the immediacy of teaching" (Cochran-Smith & Lytle, 1993), a daily teacher journal served as a space for me to record my post-lesson reflections and interpretations. Instead of written journal entries, I used an audio-recorder to document my thoughts for the sake of time. Immediately following each lesson, I took advantage of the lunch period to reflect on the day's lesson and refine on-going conjectures about student levels of engagement and participation in my teacher journal.

In each reflective "entry", I provided a summary of and overall impression of the lesson, with particular respect to student engagement and participation. I noted my impressions, questions, frustrations, and excitement after lesson implementation, and entries also provided a trace of my pedagogical decision-making with regards to changes in tasks or approaches I made during the intervention. Per my committee members suggestions at my defense proposal meeting, I also documented "critical moments" that occurred during the lesson, that is, moments that evoked strong emotion (both positive and negative) or particular incidents that continued to replay in my head after the lesson was over.

Recall that I often held post-lesson debriefing meetings with Julie as well, and these debriefings occurred after my own audio-recorded reflections. I took written notes during our meetings, jotting down her observations, thoughts, and questions as well as any new or different thoughts that came up for me during our discussions. At the end of each school day, I frequently engaged in a post-day reflection and noted any classroom interactions throughout the school day, outside of mathematics lessons that seemed significant to attend to. During the retrospective analysis phase after the completion of the intervention, I transcribed all 42 of my daily audio-recorded reflections and combined them with my additional notes from my meetings with Julie and my end-of-the-day reflections.

I also audio-recorded my daily mathematics lessons to support my retrospective analysis of the intervention and enable me to analyze my instruction from a different temporal perspective. Two audio-recording devices were used, one positioned at the front of the room and another in the back. Human subjects research approval was not granted until the second week of the intervention, therefore, I do not have audio-recordings of the first two weeks of the intervention. My teacher-reflective journal entries during the first two weeks of my teaching were particularly dense and filled with "thick description" (Geertz, 1973) of my lessons in an effort to compensate. Therefore, my analysis of the first two weeks of my teaching is based only on my teacher reflective journal, and I do not have other sources of data to confirm or disconfirm these interpretations. I acknowledge that my interpretations of the lesson and student responses are filtered through my lens during these initial weeks. After taking into account school holidays, field trips, and assemblies, 35 math lessons were recorded in total. I also collected lesson plans created from the lesson-planning framework inspired by ICA as well as the related materials from each audio-recorded lesson.

Student Data

I collected four types of student data: classwork, surveys, journal entries, and interviews. To support my on-going conjectures during the intervention, I collected students' daily class work over the course of the intervention, including daily classwork and assessments. A student survey was administered at the beginning and end of the intervention to gain information about students' conceptions of mathematics and their mathematical experiences (See Appendix C). Two additional open-ended questions were eventually added to the post-survey to gain insight into students' perspectives about the specific activities during the intervention and their mathematical experiences more broadly. Students also wrote reflective journals entries twice a week following the end of mathematics lesson. Journal prompts were aimed at understanding students' day-to-day experiences with classroom activity, and although I provided students with general sentence starters to support their writing, I left the parameters open in terms of content and encouraged students to openly reflect on and represent their experiences through drawings or writing.

Finally, I conducted individual interviews with ten students both during and after the intervention to gain in-depth information about students' conceptions of math, their overarching mathematical experiences, and their specific experiences with my instruction. In my dissertation proposal, my original intention was to hold interviews with students only once after the completion of the intervention. However, in line with the interventionist nature of design-based research, I made the in-the-midst decision to interview ten students after the first few weeks of my instruction.

As will be discussed in Chapter 5, this decision was spurred by my desire to increase student engagement and participation during classroom lessons. Specifically, the intervention was not progressing in the way I had anticipated, and in an effort to be responsive to students, I sought to gain students' perspectives through these interviews. These interviews were a pivotal turning point in enabling the development of working relationships between the children and myself for the remainder of the intervention, and this will become clearer for the reader during the presentation of Chapters, 5, 6, and 7.

I conducted two sets of interviews with ten students, both during and after the intervention. All interviews were audio-taped and transcribed. Students' interviews were used during both the on-going and retrospective phases of analysis. During the intervention, students' interview responses helped me make sense of my classroom observations during my on-going analysis, provided insight into why students were (or not) engaging, and these interviews ultimately shifted the trajectory of the classroom intervention[6]. These interviews were also used in the retrospective analysis phase as complementary data to triangulate the patterns that emerged from my analysis of students' survey responses[7].

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[6] See "An Opportunity to Regroup" section in Chapter 5.
[7] See the Data and Methods of Analysis section in Chapter 7.

The ten students I interviewed were selected on the basis of whether I had their human subjects research approval consent forms in my possession during the time of the first interview. Because approval was not granted until two weeks after the start of the intervention, student consent forms were distributed to students a few days before they were dismissed for a two-week winter break. All students had not returned their parental consent forms by the time we returned from break, therefore I interviewed students for whom I had parental consent forms in my possession at the time. I interviewed these same ten students again after the conclusion of the intervention.

Because these students were a sample of convenience, I acknowledge there may be important alterative student voices that are not represented in this study. The intent of administering a whole-class student survey to the fourth-grade students was an attempt to give voice to all students in the classroom, however, it is also important to note that there were 24 students whose perspectives I did not have access to through interviews. Despite this limitation, from my perspective, the ten students I interviewed represented the diversity among the students in the class in multiple ways. I interviewed four girls and six boys from different racial, ethnic, and cultural backgrounds, five of whom were English language learners. These students also reflected different personalities within the classroom and were in different social groups within the classroom. Students' interview responses also reflected the diverse perspectives within the classroom. That is, students' classroom experiences and the ways in which they interpreted our mathematics activities differed.

The first set of interviews was conducted in early January, during the first week after our return from winter break. The first set of student interviews took place in a small conference room located in the main office, and the second interviews took place in the school library after the conclusion of the intervention. These interviews were semi-formal in nature and probed students' answers on the student survey. I developed the interview protocol based on the particular student's responses to the pre-and post-survey, particularly in relation to student participation in the classroom and noted shifts in their answers/experiences (See Appendix D).

As noted earlier, I was conscious of the authoritative and social power I held as their teacher when conducting these interviews. I did not want students to feel obligated to participate even if their parents had granted permission. Therefore, I asked students whether or not they were willing to participate, and ultimately all ten students chose to be interviewed. I took caution during interviews to attend to students' levels of comfort, and I paid close attention when I posed questions, monitored student body language and facial expressions. I remained careful not to push students to share their thoughts with me if they appeared hesitant to do so.

Overview of Analytic Methods

The purpose of this study was to understand how caring pedagogical relationships are established and maintained through mathematics practice and to examine how this relationship influences student mathematics learning, with particular respect to students' emerging dispositions and classroom participation. Therefore, the overarching goal of data analysis was to investigate the enactments of care I provided through my mathematics instruction and how students responded to these enactments of care as evidenced by their engagement and participation during mathematics lessons. In other words, to examine the process by which this relationship was developed, it was necessarily to coordinate interpretations of what the teacher and student were doing from the two perspectives (Cobb et al., 2001).

To meet these aims, I focused on different data sources and drew on different analytic methods when analyzing my instructional practices (in Chapters 5 and 6) and students' mathematical dispositions and classroom experiences (in Chapter 7). In this section, I provide a brief overview of my overall approach to the entire data corpus and introduce the analytic methods I used to investigate different phenomena. I provide a detailed description of the specific data sources and methods of analysis used in each analytic chapter.

To begin the "process of bringing order, structure, and interpretation to the mass of collected data" (Marshall & Rossman, 1990, p. 150), I first organized my data in a data records excel document to coordinate all of the data sources, including teacher-reflective journal entries, audio-recordings of lessons, lesson plans and related student artifacts, student surveys, and audio-recordings of student interviews. Organizing the data in this way gave me an initial sense of what the broad corpus looked like, and the physical act of sorting and compiling hard copies of paperwork such as lesson plans, student surveys, and student artifacts support me in "getting to know" the different data sources. The data records excel document also provided me with a temporal sense of the data and an opportunity to immediately triangulate data sources as well.

Data on my instructional practices were collected primarily from my teacher reflective journals entries, transcriptions of audio-recorded lessons and, to a lesser degree, lesson plans and student artifacts. The primary sources of data I drew on to analyze students' mathematical dispositions and mathematical experiences were student pre- and post-surveys, student interviews conducted twice during the intervention, and my teacher reflective journal was used as a secondary source.

Broadly speaking, my analytic approach to the data corpus was guided by the interpretivist tradition and focused on understanding meaning and context (Erickson, 1986). Data were analyzed through the principles and methods of constant comparative analysis (Glaser & Strauss, 1967) for the purposes of examining how the process of caring manifested itself in my instructional practices, and understanding how these practices shaped student mathematical learning, with particular respect to their students' emerging dispositions and participation.

Using my research questions as a tentative guide, I worked in an iterative process and moved between and among the data to identify patterns, code data, create categories, group categories into themes, and develop tentative hypotheses throughout the analysis. Theoretically, I de-contextualized and re-contextualized the data to reduce and then expand (Tesch, 1990) in an effort to think about and with the data (Coffey & Atkinson, 1996). I looked for linkages among the data by examining patterns within and across data sources in a process of "progressive problem-solving" (Erickson, 2004, p. 486). I developed assertions based on emergent themes through the process of writing analytic memos, and tested, revised, and refined these themes through a repeated process of reviewing the data corpus to ensure the "validity of the assertions that were generated, seeking disconfirming evidence as well as confirming evidence" (Erickson, 1986, p.146).

Summary

In this chapter, I provided an outline of my research design and methods used in this study. I described how the theoretical framework of an integrated caring approach shaped the design and implementation of the classroom-based intervention, and I introduced the readers to the context and participants involved in this study. I also explained my methodological choices, data collection methods and sources, and provided an overview of my analytic methods.

The description of the classroom-based intervention provides important context for making sense of the analysis presented in the following three analytic chapters. To begin the empirical line of inquiry, I draw on narrative inquiry methodology in the next chapter and offer a close analysis of my classroom experiences during the early weeks of the intervention.

CHAPTER 5: THE INITIAL WORK OF BUILDING PEDAGOGICAL RELATIONSHIPS

Overview

This chapter examines the initial work involved in the process of building student-teacher relationships through the pedagogical approach of an integrated caring approach (ICA). Through the use of narrative inquiry (Creswell, 2007; Denzin & Lincoln, 2008), I describe my early experiences implementing ICA in the fourth-grade classroom from the lens of the one-caring teacher who was also viewed as "the substitute teacher". When one considers the place of story in teacher education, Carter (1993) argues that, "a story…is a theory of something. What we tell and how we tell it is a revelation of what we believe" (p. 9). Yet, she reminds us that stories exist within a particular social context and, therefore, of the importance of being clear about what our purposes are when telling stories in our research.

I specify that the story I tell of my classroom experiences in the fourth-grade classroom provides a rich and complex means for understanding the "unforgiving complexity" (Cochran-Smith, 2003, p. 3) involved in the work of teaching. Namely, the complexity involved in establishing productive working relationships with a class of 34 students, and the juxtaposition between caring for students personally, on the one hand, and caring for students mathematically, on the other, particularly when students and teachers hold varying conceptions of the discipline and what counts as mathematical competence. What is more, I aim to make a case for why, in "the buzzing, blooming confusion of real-life settings" (Barab & Squire, 2004, p. 4), building relationships with students is integral, not peripheral to the work of teaching mathematics.

Noddings (1995) reasons that, “caring implies a continuous search for competence. When we care, we want to do our very best for the objects of our care” (p. 676). And so it follows that a parallel story I pursue here is about my own quest for teacherly competence in the fourth-grade classroom. Therefore, I share my experiences not only from the perspective of the teacher-researcher who was investigating the role of pedagogical relationships in the classroom, but from the perspective of the teacher who was “not by status or knowledge a priori right; she is just one-caring – who wants to do what is right and remains willing to explore the possibilities” (Noddings, 1984, p. 124).

The inquiry in this chapter is guided by the overarching research question:

- How does an integrated caring approach influence a teacher’s mathematics instruction in one fourth-grade classroom?

Data and Methods of Analysis

Denzin and Lincoln (2008) define narrative inquiry as “retrospective meaning-making” (p. 65). Specifically:

> Narrative is a way of understanding one’s own and other’s actions, of organizing events and objects into a meaningful whole, and of connecting and seeing the consequence of actions and events over time (Bruner, 1996; Gubrium & Holstein, 1997; Hinchman & Hinchman, 2001; Laslett, 1999; Polkinghorne, 1995). (p. 64)

Seen this way, narrative is a useful device to make sense of one’s own experiences, and impose order and coherence on a particular stream of events. Creswell (2007) argues that narrative inquiries have a specific contextual focus, and, as an example, Drake and Sherin (2006) have used mathematics teachers’ narratives as a tool to help make sense of the ways in which the teachers adapted reform curriculum. Taken together, narrative is a vehicle to encapsulate and interpret human experience and serves as an important source of knowledge.

To develop the narrative below, I analyzed my teacher-reflective journal entries from the first few weeks of the intervention to "restory" (Creswell, 2007) them into an organized framework consisting of key elements and emerging themes and ideas. When possible, transcripts from classroom lessons and student surveys served as secondary data sources to "flood in" the details of the framework. Speaking personally, but meant generally, the narrative I present is intended to describe the initial work involved when teachers strive to develop productive working relationships with their students as they aim for ambitious mathematical outcomes. In addition, narratives can include epiphanies, or "turning points in which the story line changes direction dramatically" (Creswell, 2007, p. 57). Therefore, I identify critical moments that, from my perspective, shaped the relationship-building path the students and I took for the remainder of the intervention.

The discussion in this chapter also provides necessary groundwork for the empirical work in the following chapter, specifically by paving the way for the presentation of four caring practices that emerged in my mathematics instruction. Providing the reader with a sense of the classroom milieu during the early stages of the intervention is essential for understanding how and why my instruction evolved the way it did across the remainder of the intervention.

Getting to Know the Fourth-Grade Class

To begin the process of building working relationships that aimed to enhance student mathematics learning, I needed to accomplish the preliminary task of getting to know students both personally and mathematically. Initially, some of the students were eager to get to know me, others were shy or stand-offish, and others seemed indifferent. The first two weeks in the classroom were especially bumpy. The large number of students made things particularly difficult. There were so many students to get to know. When I looked out at the group, they appeared before me like a sea of 34 blended faces.

When doing recess duty on the playground on my second morning, a brown-haired girl darted over to give me a quick hug before scampering away to the tetherball poles. I remember staring after her wondering, “Who was that, and is she in our class?”. Even when I recognized their faces, I had a hard time keeping their names straight in the classroom. It was particularly challenging for me to tell Daniel and Stephen apart. They were both short White boys with light brown hair who often wore dark short-sleeved t-shirts. After being mistakenly identified by me one too many times, Daniel yelled out in exasperation one afternoon, “I’m not Stephen!”.

There were so many *things* to learn about. I had anticipated working to learn about the students and the curriculum, but I had forgotten about the countless small, yet critically important things a teacher must also be aware of to do her work. How did I enter the daily class attendance and lunch count into the computer? What time did Jamal, Alyssa, and Gerardo leave the classroom to go to the Learning Center? What time was lunch during rainy day schedules? Which button did I push on the phone to call the front office? Which students rode on Bus A? Bus B? Bus C? Was it Thursday afternoons when students needed to put their chairs up on their desks so the custodian could vacuum the floors? What was the copy machine code again? And where in the world did all the sharpened pencils in the communal jar keep disappearing to?

I did not feel a connection to the class immediately, and I suspect neither did they to me. I was a newcomer entering a community that had developed rituals and ways of interacting over the past three months since the start of the school year. There were subtle reminders of this. Students' cries of "Mrs. Tseng! Angela's not supposed to be at the library! We're *not* allowed to go if three people are already there!" or "But we alllwaaays go to lunch early! If we don't, then we have to wait behind the fifth- and sixth-graders!" reminded me there was an established way of doing things in Room 7 that I was not privy to.

And there were overt reminders that led me to feel not as a newcomer, but as an outsider. Recall that I was not only a new teacher, I was also the *substitute* teacher or, crudely put, a replacement for the "real" thing. I was aware of the baggage that came with this unceremonious label from my former life as a third grade teacher. Letters left for me at the end of the day by substitute teachers who had filled in for me when I was away from the classroom provided written documentation that even the most well-behaved group of children had the potential to become a bunch of rabble-rousers for a teacher associated with the word "substitute". The fourth-grade students did not know my past as an elementary teacher. Unsurprisingly, positioning myself as a former teacher of the district did not carry any weight with them whatsoever.

I struggled with managing students' behavior in ways that I hadn't fully anticipated. The students were a chattery bunch, and it was difficult to maintain their interest or support them in staying on-task for an extended period of time. There was a group of five to six boys who could be defiant. Both Mrs. O, the teacher on leave, and Julie, the teacher intern, assured me that what was happening was not a radical departure from their experiences. In an email I wrote to Mrs. O describing the actions of the whole class and of particular students, she wrote back, "Your day sounds exactly like all my days there!" (personal communication, November 26, 2012). Although she felt that a few students were "testing" me, Julie also suggested students' actions were not out of the ordinary. I am unsure whether they were both only saying these things to be supportive (or to ensure I didn't pack up and leave!). One day after school, however, I discovered a stack of written discipline reports in Mrs.O's desk drawer involving the same boys I was struggling with, which rightly or wrongly made me feel better about my competencies.

Initial Implementation Attempts

My initial attempts at teaching math made clear that my management issues impacted the overall learning environment and the mathematical goals I was aiming for. My lesson on the third day was a mess. I voiced in my teacher-reflective journal:

> Holy smokes. That lesson did not go well. I was talking the whole time or actually talking *over* them the whole time. I couldn't get the class to listen to me long enough to present the task, so the discussion around the [task] launch did not happen the way I wanted. I was yammering away at them the whole time, and I didn't like it. (Reflective Journal, November 28, 2012)

My attempts at creating opportunities for students to engage more substantially during the lesson went unheeded, and both the classroom space (or lack of) and the class of students frustrated me:

> [But] I didn't know what else to do. When I tried to give them time to work to solve the problem in pairs then some of them – mostly the group of boys – started goofing off. I can't even describe how noisy it was in here and not in a good way…I felt stuck up [in the front] because there's just not enough room to circulate. And, I still don't even know all their names. There are just so many kids. It was so hard to get them all on-task – worrying about how I was going to respond to them mathematically isn't even an issue at this point. (Reflective Journal, November 28, 2012)

And I tried to remain cautiously optimistic after another failed attempt even as the reality of the challenging task that lay ahead began to set in, "…it's only the first week. I think it will get better? I hope it gets better. But [this will be] way harder than I thought" (Reflective Journal, November 30, 2012).

The pedagogical approach of ICA offers a "guidebook" (Labaree, 2000) to foster the development of pedagogical relationships that advances student mathematics learning, namely by highlighting the multiple dimensions involved in establishing these relationships. Yet it does not concretely "tell us how to teach mathematics" (Simon, 1995, p. 114). It also does not provide one with answers for how to proceed when problematic situations arise in their specific circumstances.

For example, ICA did not directly point the way for what to do when Isaiah covered his paper with his arm to prevent me from seeing his work (November 28, 2012), how to persuade Emanuel and Leena to listen to one another's ideas (November 29, 2012), how to teach Rohan and Nakari to disagree politely (December 6, 2012), what to do when Kyler repeatedly flicked his linker cubes across the room at Stephen instead of using them as mathematical models (December 4, 2012), how to encourage students other than David and Lacie to share their solutions publicly with the class (November 30, 2012; December 3, 2012; December 11, 2012), or how one teacher could substantively monitor and probe the mathematical activity and thinking of over 30 students to carefully plan for the whole class discussion all within a restricted amount of time.

Searching for a Solution

I felt overwhelmed and defeated in those initial weeks. In my dark moments, I wondered if I had taken on too much. When I stood in front of the class waiting for students to quiet down and turn their attention towards me, I couldn't help but glance wistfully at the kidney-shaped table in the back of the room. How I wished I could be the researcher observing the students from the back of the room, offering sympathetic and encouraging smiles towards the teacher at the mercy of a group of energetic children instead of the impatient teacher who was waiting. I worried that I wouldn't have anything to show for my research at the end of the intervention: how could I possibly collect data on my practice when I didn't feel as if I was actually teaching? And I also felt a deep sense of hypocrisy: how could *I* be a teacher educator when I couldn't "pull off" the practices I advocated for in my methods courses?

I searched for explanatory reasons in an attempt to shed light on and provide directions for potential solutions. Initially, I turned my focus inward towards my own perceived deficits, throwing out a number of possibilities in my journal: "Maybe I need to be more strict" (November 29, 2012), "Would this be different if I had stronger [math] content knowledge?" (November 30, 2012), "I don't think I thought this through enough" (December 3, 2012), and "I wonder if I've been away from the classroom for too long. Or as [another graduate student] always says, we've drunk the kool-aid" (December 3, 2012).

But I also suspected there was more going on. My vision of ICA had presupposed "a very friendly interpretation of possible sources of difficulty" (Lensmire, 1994, p. 27). Like others who put forth a set of instructional practices designed to enhance student outcomes, I had underestimated the strength of contextual influences in everyday classroom life; namely, the invisible yet enduring forces that transcend curricula and ambitious instruction. As Lensmire emphasizes, these proposals often assume:

> …that everyone, more or less, is interested in doing things in these new ways but gets hung up when they use old knowledge in a new setting. It forgets conflict. It ignores that teachers and students sometimes take up adversarial roles. Children's "old" knowledge…certainly includes knowledge of how to help things go smoothly, how to cooperate, but it also includes knowledge of how to disrupt, resist, engage the teacher in classroom warfare. (p. 27)

In its simplest form, my notion of the relationship-building process rested on a two-fold process: first, create strong instructional opportunities for students to learn, then leverage my relationships with students to enable them to take up these opportunities, thereby advancing mathematics learning via increased engagement and participation. This vision now seemed comically naive from my new point of view as an insider.

As Eisner (1992) reminds us, "there is a profound difference between knowing something in the abstract and knowing it through direct experience" (p. 263). Most of the class did not seem particularly interested in learning mathematics as a process of sense making, and I hadn't had the opportunity to develop strong or even stable relationships with students. I was still in the process of getting to know them collectively and individually. I was certainly nowhere near "know[ing them] well mathematically, racially, culturally, and politically" (Bartell, 2011, p. 65). In short, there was nothing for me to leverage.

The tenuous state of our classroom relationships necessarily shaped the strength and nature of the mathematical opportunities I could provide. For example, it was difficult to remain sensitive to students' current mathematical understandings because I did not have a good sense of where students were developmentally, thus I was unsure what kinds of tasks might present productive rather than unproductive struggle. It was difficult to anticipate how far to push students mathematically, and I hadn't yet developed a sense of how long I could hold whole class discussions before the majority of the class disengaged either quietly or overtly. I didn't know enough about the existing classroom social dynamics to know which students could work together productively or which "lower status" students to position as mathematically competent.

Simon (1995) explains that "initial hypotheses [of learning trajectories] often lack data that are available as work with the students proceeds…[and] hypotheses are expected to improve (i.e, become more useful)" (p. 132) as data is generated. The data most integral for strengthening my conjectures, however, were my growing awareness of who these students were as individuals and mathematics learners. As Lampert (2001) articulates, "like the mathematics, the communication of trust, disapproval, enthusiasm, caring, skepticism, confidence and the like is both carried in momentary encounters and constructed in relationships over time" (p. 38). Developing relationships required sustained interactions with these students (Noddings, 1984), and time was not yet on my side.

Return to Daily Spiral Review

After the first week, I was at a loss for what to do next. I had a week's worth of mathematics lessons prepared through the lens of ICA, but no Plan B in my back pocket. I felt as if I was swimming aimlessly underwater searching for a breath of air. My vision of an integrated caring approach was in trouble, and I had reached "the point where it is no longer acceptable to say we are teaching when no learning follows from our efforts" (Fenstermacher & Richardson, 2005, p. 188).

Thus, I made the choice to scale back the use of problem-based tasks during the second week and returned to opening each lesson with Daily Spiral Review (DSR) in the way students were accustomed to. This was spurred, in part, by my observations that the class was more manageable and more willing to “engage” with the mathematics if the lesson was more structured, when I provided more directions, and we worked out the problems together as a class. As I reflected:

> I hate myself a little for saying it, but starting lessons with spiral review has been like a relief. So much less frustrating for me and the kids. Teaching with tasks feels like such a fight...They respond better to DSR and it seems like they’re learning something – on a surface level at least. And I know it shouldn’t be about me, but it makes me feel like a better teacher when they’re sitting there working [on the problems from DSR] and doing something. But then I also feel like [crap] because I know I’m not providing them with meaningful opportunities really. These problems aren’t providing opportunities to engage with the math conceptually…there’s nothing to grapple with, but it holds their attention. I know that isn’t the same as learning…[but] it’s like [the class is] forcing me into a way of teaching that I know isn’t good, that I know I shouldn’t do. (Reflective Journal, December 5, 2012)

Brousseau (1997) posits that an implicit yet abiding “didactical contract” exists between students and teachers in mathematics classrooms; specifically, students and teachers hold a set of reciprocal expectations for one another, and as a result, particular roles are created for each party to take up. My journal entry above illustrates my underlying awareness of this phenomenon in our fourth grade classroom. Students were communicating to me through their actions that I was breaking my end of the contract, and they were unwilling to revise their old ways of learning mathematics. Thus, I was faced with a choice: I could risk continued student resistance by holding steadfast to my commitment to teaching mathematics through the vision of ICA and go against student expectations; or in an effort to keep a tranquil classroom environment (Kennedy, 2005), I could revert back to the mathematical practices familiar to students.

Feminist theorist Sara Ahmed describes situations such as these as “wall encounters”. She illustrates:

> You encounter a brick wall…[but] to those who do not come against it, the wall does not appear. Things appear fluid. Things *are* fluid if you are going the way things are flowing. We can reflect on the significance of frustration here: it is not only that the wall keeps its place, but those who don't come against it, don't notice it. This can be profoundly alienating as an institutional experience. No wonder that when the wall keeps its place, it is you that becomes sore. (Ahmed, 2013, emphasis added)

I was sore all right, and neither option seemed particularly appealing to me. What is more, I was unsure which choice would be more responsive to the needs of this fourth grade class. Which pedagogical choice was the more "caring" thing to do? The more "mathematical" thing to do? Weren't they supposed to be one and the same according to my theoretical model?

My journal comment that the students were "forcing" me to return to using DSR also reflects my awareness that I was, in some sense, at the mercy of the students. I could not reach my intended instructional goals unless they chose to be "willing participants" (Cohen, 2005). The student-teacher interactions occurring in the classroom reflected the dynamic outlined by Haberman's (1991) notion of the pedagogy of poverty in that:

> …students reward teachers by complying. They punish by resisting. In this way students mislead teachers into believing that some things 'work' while other things do not. (p. 292)

But as Cohen also rightly points out, being a willing participant means "acquir[ing] new skills, habits, understanding, or states of organization which is often difficult and risky" (p. 284), and I had a sense that students' resistance was linked to these affective aspects of learning mathematics.

Adding further complexity to my dilemma, though not explicitly documented in this reflective journal entry, my decision to return to using DSR was also motivated by my awareness that I needed to cover the curriculum in a more expedient manner than I was currently doing. Teaching through problem-based tasks took a significant amount of time, and I was falling behind the unofficial pacing guide set by the date given to assess students using *Illuminate's* interim benchmark assessments.

Breaking the Surface

My first breath of air came during the third week of the intervention. Hackenberg (2005a) posits that in situations when the students are frustrated, or when the teacher feels overwhelmed with the task of caring, a teacher "persists as mathematical carer in these situations because of [her] own memories and images of being mathematically cared for and of caring mathematically" (p. 49). From my perspective, the lesson segment I present below marked a critical turning point in facilitating the formation of a working relationship between the class and myself.

I had spent the previous week beginning lessons with Daily Spiral Review. Although the multiple choice problems of DSR did not offer substantial opportunities to engage in problem-solving per se, I attempted to provide opportunities for mathematical sense-making by pushing students to explain their answers and encouraging others to articulate reasons why they agreed or disagreed with that student's answer. I had noticed a shift in the length of time students were willing to listen to their classmates and on December 10, I re-attempted to open the lesson using a problem-based task.

The problem I posed was situated in the context of the school. It read:

> *Oakwood School has 595 students. All grades have the same number of students. How many students are in each grade?*

A primary aim during the task launch was to support students in making sense of the problem situation before solving the problem on their own (Jackson & Cobb, 2010). A key idea that would enable students to substantially participate in solving this particular task was for students to have an understanding of how many grade levels there were at Oakwood School and that there were the same number of students at each grade level. I aimed to support students in unpacking the problem situation and developing an understanding of the mathematical relationships in the task during our introductory discussion.

Sofiya first suggested that we needed to have a sense of how many grades there were at the school, and I asked the class:

> NT: Can anyone explain why it's important to know how many grades there are in the school before we start to solve the problem? Emanuel?
>
> Emanuel: Because we're trying to…like we're trying to figure out how many kids are in each grade.
>
> NT: Okay. And how does knowing how many grades there are help us do that? David?
>
> David: Well it says there's the same…like an equal number of kids in each grade. So then we know how many grades to put all the kids into.
>
> NT: Great. I like the way you used your own words and substituted the word "equal" for "same". And by "all the kids" you mean…
>
> David: All the kids in the whole school.
>
> NT: Okay. So, what you're saying is that it's important to know how many grades or groups there are in the school before we can figure out how many kids there are, um, at each grade level, is that right?
>
> David: Yeah.

Dude[8] thoughtfully posed another question that he had been wondering about:

> Dude: Wait, does Kindergarten count as a grade?
>
> [Chorus of yeses and nos from the class]

---

[8] Students were given the option of choosing their own pseudonyms, and I selected pseudonyms for those who did not chose names on their own. Dude explained that he chose this particular pseudonym because it made him feel "cool".

At this point, I noticed that Dude's question had generated some buzz within the classroom among the students.

> NT: Oh! Great question. Why are you wondering about that, Dude?
>
> Dude: Because it doesn't have a number in the grade. Like, you know, *first* grade or *fourth* grade or something like that.
>
> NT: Ah, so you mean because we use the word Kindergarten to represent that grade, maybe it shouldn't count as a grade?
>
> Dude: Um-hmm.
>
> NT: I see. I like the way you're thinking about this. What do you all think? Should Kindergarten count as a grade? Jewel?
>
> Jewel: I think it should count.
>
> NT: Why?
>
> Jewel: 'Cause they are a grade! There's like just no number for them.
>
> NT: Okay, good reasoning. Who else has something to say? Wow, I love that so many of you are willing to share your thinking. Lacie?
>
> Lacie: Maybe they should be called zero grade.
>
> NT: Well, they are sort of little, aren't they? It can be hard to see them sometimes. [Laughter] I wonder…would that change our answer, if Kindergarten didn't count as a grade in this problem? Maybe we should try it both ways. (Lesson Transcript, December 10, 2012).

This piece of the discussion demonstrates evidence of an evolving set of interactions between the class and me that could be characterized as reflective of an integrated caring approach, particularly in relation to Dude's question. Although the question that Dude posed may have appeared "non-mathematical" or could have been interpreted as a potential digression from the mathematical discussion, negotiating whether or not Kindergarten should count as a grade was an important aspect of making sense of the problem situation. I was interested and open to seeing how he was thinking about the problem, and I was conscious of the fact that Dude's question had piqued the interest of the class. In this way, I leveraged his question to bring more students into the class discussion and attempted to orient students to think about his question in relation to the problem situation described in the task. Humor can also be considered a form of teacher caring (Moje, 1996), and Lacie's comment of "zero grade" offered the opportunity for me to inject a small joke into the discussion, which (some of) the kids presumably appreciated as reflected by their laughter.

In a broad sense, my posing of the mathematical task can be seen as an enactment of care on my part and, in turn, the class's responsiveness and subsequent mathematical engagement throughout the remainder of the lesson indicated that they recognized and received my attempts to care. In my reflective journal, I suggested that the lesson went "really well" and that we'd had a "great discussion". I was also pleased with the whole-class sharing aspect of the lesson. As I noted:

> Three pairs of kids came to share their solutions with the class…each of their strategies were different and it was great to have all three [solutions] up there. Most of the class seemed pretty engaged and interested in how the other kids approached the problem. (Reflective Journal, December 10, 2012)

Students' willingness to engage in the activity also provided me with "the gift of responsiveness" (Noddings, 1984, p. 72), enhanced my subjective vitality (Hackenberg, 2010), and stimulated and enabled me to continue my attempts to pose problem-based tasks through ICA. As Noddings posits, "one must have legitimate opportunities to care, in order to go on caring effectively" (1984, p. 122), and the student-teacher interactions during that lesson reinvigorated me.

Importantly, the lesson on this day also served as a way for me to view my abovementioned perceived dilemma in a different light. That is, I now saw that my desire to be responsive to students' needs did not necessarily have to bump up against my goals of ambitious mathematics practice. As Noddings' (1984) describes it, being receptive towards the student does not mean that one must discard their professional goals. Instead:

> My motive energy flows toward the other and perhaps, although not necessarily, toward his ends. I do not relinquish myself; I cannot excuse myself for what I do. But I allow my motive energy to be shared; I put it at the service of the other. (p. 33)

Seen this way, taking an integrated caring approach to mathematics instruction would manifest itself in how I bridged my perception of students' needs with my own instructional goals to support their development as mathematics learners.

An Opportunity to Regroup

Shortly thereafter, I took advantage of the two-week winter break from school and used it as an opportunity to reflect on my efforts at implementing ICA thus far. I combed through the data I had collected: reading through my reflective journals, going over student classwork and analyzing student responses to the pre-survey I had given during the early weeks of the intervention. My analysis of student responses was particularly illuminating and supported me in making sense of my classroom observations of students' engagement and participation.

The pre-survey was designed to tap into students' views of mathematics and mathematics learning, and student responses revealed that most of the class held fairly traditional notions of the discipline, what it meant to do and learn math, and what it meant to be a "good" mathematics learner. I discuss students' perspectives in further detail in Chapter 7, but it is important to share aspects of students' responses here to demonstrate how my understandings of student mathematical experiences influenced my pedagogical choices for the remainder of the intervention.

Several predominant themes related to students' conceptions of the discipline and what it meant to be a "good" mathematics learner emerged among student responses. For example, in response to the question, "What does it mean to be good at math?", evidence indicates that many students: 1) conceptualized the discipline in general ways, 2) related it to getting answers "right" and/or getting a good grade, or 3) linked it to particular behaviors, some of which alluded to the notion of the teacher as mathematical authority. Specifically, eight students described being good at math in non-specific terms, suggesting that it meant "[being] excellent", "[doing] well", or "[doing] a good job". Nine students suggested that good math learners rarely made mistakes; specifically that they "always get the answer right" or "do perfect". In addition, nine students indicated that good mathematics learners "pay attention", "practice a lot", "show their work", "listen to the teacher", or "don't need any help from teachers".

Importantly, for several students, the notion of struggle was negatively associated with learning mathematics. In the view of six students, those who are good at math "don't have trouble" and "can answer the problem easy". Some also associated being a good math learner with knowing their basic math facts, solving problems quickly, or viewed learning mathematics as a solitary enterprise. To a lesser degree, several students did view learning mathematics as an exercise of problem-solving. For example, four students mentioned that good math learners knew how to "solve problems" or that doing math "helped your brain think like problem solving". Five students also indicated that being good at math involved the notion of persistence, and good learners “always finish and check [their work]”, “try to do the one that [they] don’t get”, or “work hard”.

Students’ responses were not mutually exclusive, but some responses revealed potentially competing views of what it meant to be good at math. For example, on the one hand, Jason suggested that being good at math meant, “[to] never get a wrong answer” and also “ to work hard and to know everything”. Carol indicated that good math learners, “know the anser [*sic*] right away” and “to never stop trying hard”.

Student responses on the multiple-choice portion of the survey also provided me with useful information. In particular, the question related to whether or not students “like to share their strategies in class,” gave me insight as to why I observed Lacie and David volunteering to share their mathematical ideas so often during our whole-class discussions. These students indicated they liked sharing their strategies “most of the time”. Four students selected the answer “Some of the time” but the overwhelming majority of the class, 21 students, revealed that they either “never” liked to share strategies or only did “a little bit”.

Like the mathematics lesson described earlier, the insights I gained from my analysis of student surveys marked another critical turning point for me during the intervention. These surveys served as an essential window that allowed me to glimpse mathematics lessons from the perspectives of my students and begin to understand *their* classroom experiences as mathematics learners. For example, it seemed possible that my unsuccessful attempts to support students in engaging with a task for a longer period of time was potentially related to what students believed the notion of struggle indicated. Namely, that “good” math learners were those who could solve problems quickly and easily, and struggling with a math problem indicated that one was "bad" at math. In addition, I came to see that students' lack of participation during whole-class discussion was not necessarily a sign of disengagement, but perhaps a sign of student *reluctance*, reluctance stemming from reasons that, although I had some hypotheses, were still largely unbeknownst to me.

To that end, I planned short interviews with individual students when we returned to school after the winter break to gain deeper insight into their survey responses. Taking advantage of Julie's student teaching requirements to teach the class without my presence in the classroom, I held short, one-on-one interviews with 10 students across a two-day time period. As Civil and Planas argue (2004), "students themselves are aware of the social and organizational structures in place and of the effect of these on their [mathematical] participation" (p. 8), and students' interview responses provided me with additional insight that strengthened my on-going analyses and conjectures.

Specifically, the patterns that emerged from my conversations with these children both supported my findings from their survey responses and also led to deeper understandings. For example, several students indicated that they believed they learned mathematics best by paying attention, following directions, and practicing. I also learned that the nature of the peer relations among the students within the classroom, the associated public risks of whole-class strategy sharing, and the increased class size from 20 students in third grade to the current group of 34 strongly influenced students' inclination to participate in mathematical activities.

Students also revealed to me ways in which they would be more likely to share, for example, if they could present their strategy to the class in small groups, were certain that their solution strategy would lead to a correct answer, or if they believed that sharing their thinking might help their classmates learn more.

My interviews with these students also led me to realize that, not unlike my experiences teaching mathematics in a new way with a new group of students, they too were being asked to engage in a new way of learning mathematics with a new teacher. The mathematical opportunities I was both creating and aiming to enable students to take up was creating new expectations for what it meant to be a mathematics learner in the classroom. As a result, trying on these new roles and learning how to participate in novel and more public ways was raising uncomfortable intellectual and affective tensions for students. Tensions that, not unimportantly, ran parallel to the ones I was also struggling with as their teacher.

Although I believed the ways in which I was positioning students vis-à-vis the mathematics was valuable, the students did not necessarily share my thinking. I came to see that in addition to creating opportunities to learn through ICA, part of what would enable students to take up these opportunities would be for them to come to see these opportunities as useful and important ways of learning mathematics themselves, or in Noddings (1984) terms, turning these opportunities to learn into opportunities to *care.* The insights gained from student interviews illuminated a path for how I could interact with students in ways that would support their participation during mathematical activities in stronger ways than I had currently been providing.

Although I did not set out with this mind, these interviews unintentionally created a space for the students and me to mutually engage in the caring practice of dialogue (Noddings, 1984). In retrospect, although I call them “interviews”, in truth, these interactions resembled conversations rather than clinical interviews. Students and I took turns sharing and listening, and my "willingness to give primacy…to the goals and needs of the cared-for" (Goldstein, 1999, p. 656) was an enactment of care on my part.

As Kim and Schallert (2011) articulate, dialogue is a mechanism that allows us to construct who we are in relation to another person and, as a result, establish a connection between one another. Hearing students' perspectives allowed me to see ICA through their eyes, and I became acutely aware that the flip side of *teaching* mathematics in ambitious ways meant *learning* mathematics in ambitious ways, and I had not been nearly sensitive enough to the heightened pressures created for these students as they engaged in the process of learning mathematics.

Perhaps most importantly, however, "hearing" student voices led to my powerful realization that – despite my 100+ page dissertation proposal proclaiming the importance of "attending to students' needs" through an integrated caring approach to mathematics practice – thus far during the intervention, I had been attending to their needs through *my* perspective and not from the unique perspectives of the students in this fourth grade class. To borrow the words McClain (2002) used to describe her classroom experiences as a teacher-researcher, "I was attempting to only influence instead of also *be* influenced by the students' actions" (p 223, emphasis added). I had been so consumed with adjusting to the multiple aspects of my role as teacher-researcher and figuring out how to "manage" the classroom that I had neglected to engross (Noddings, 1984) myself in what the experience of ICA was like for the fourth grade class.

Together with my own classroom observations, students' survey responses and individual perspectives served as critical pieces of the puzzle. In particular, coming to understand students' classroom experiences provided me with the guidance and direction I was seeking as I attempted to design and implement lessons that would lead to my goal of enabling all students to substantially participate (Jackson & Cobb, 2010). As Cook-Sather (2002) suggests, understanding classroom experiences from students' perspectives "is more than simply an interesting experience [for teachers], it can help teachers make what they teach more accessible to students" (p. 3). Thus, armed with a clearer sense of student experiences, I was ready to attempt to (re) create mathematical opportunities for students to learn because "part of what it means to master any craft is to learn how to turn the constraints…into opportunities for design" (Cook and Brown, 1999, p. 389).

Summary

The purpose of the narrative analysis presented above was to capture the relational complexities – from the teacher's point of view – that arise in the work of teaching (Lampert, 2001; see also Ball & Wilson, 1996). *Caring*, or the work of forming productive relationships with students, is not about "gentle smiles and warm hugs" (Goldstein, 2002, p. 9), nor do these relationships simply materialize in the classroom. Establishing and maintaining positive working relationships with a diverse group of students is complex work, particularly when one strives for ambitious and equitable learning outcomes. As Lampert (2001) notes, "at the same time the teacher is getting to know students and respecting who they are, she is trying to change them" (p. 267). Wrestling with difficult ethical and intellectual issues while simultaneously struggling with one's own sense of professional competence is at the heart of teaching.

My goal here was to describe my classroom experiences and interactions with the fourth-grade students in such a way that the reader would "know teaching" (Lampert, 2000, p. 168) in the same way I did during the early weeks of the classroom-based intervention. In addition, the description here sets the stage for the following chapter where I present four caring practices and related instructional strategies that emerged from an integrated caring approach to mathematics practice.

CHAPTER 6: THE EMERGENCE OF FOUR CARING PRACTICES

Overview

In the previous chapter, I provided a narrative account of the initial work involved in building pedagogical relationships with the fourth-grade class, and the ways in which I strived to get to know students as individuals and mathematics learners to enable their mathematics learning. This chapter extends those findings by illustrating how the theoretical framework of an integrated caring approach (ICA) – specifically, the three dimensions of personal, mathematical, and political care – manifested itself in my mathematics instruction across the 12-week intervention.

Recall from Chapter 3 that I suggested the three dimensions of personal, mathematical, and political care represented a decomposition of the complex practice (e.g., Grossman et al., 2009) of building pedagogical relationships. As Grossman and colleagues articulate, the purpose of decomposing practice is to plan for its use; that is, focusing on each component separately in the planning phase with the ultimate goal of "reintegrating" (p. 54) the components during interactive moments of practice. Therefore, in the discussion of my mathematics instruction below, I do not specifically parse my practice along the dimensions of personal, mathematical, and political care but instead present an analytic recomposition of the three dimensions of care.

In Cook and Brown's (1999) terms, "knowledge is a tool of knowing, [whereas] knowing is an aspect of our interaction with the social and physical world, and…the interplay of knowledge and knowing can generate new knowledge and new ways of knowing" (p. 381). Seen this way, the framework of an integrated caring approach (i.e, knowledge) served as a pedagogical tool that guided my interactions with the students in the classroom, and the three dimensions of care were deployed simultaneously and in relation to one another in "real-time" in the fourth-grade classroom (i.e., knowing).

Specifically, I present four caring practices and related instructional strategies that evolved from an integrated caring approach (See Table 1). Taken together, these patterned ways of interacting with the fourth-grade students across the intervention represent a set of practices aimed to enable the formation of productive pedagogical relationships and enhance student mathematics learning, with particular respect to their classroom participation and emerging dispositions. I refer to these practices as *caring practices* because they reflect my goal of being responsive to students' perceived needs while concurrently striving to advance student learning. For my purposes here, I define a practice as "a coherent, socially organized activity that has – internal to it – a notion of good and a variety of implicitly or explicitly articulated common meanings" (Benner & Gordon, 1996, p. 44).

My analytic focus on instructional practices is motivated by the desire to examine how teachers care for their students on a whole class level and how aspects of mathematics instruction can serve as a *collective* enactment of care (in contrast to individual enactments of care). Focusing on how teachers demonstrate care on a collective level provides a way to analyze how the process of caring is represented through one's mathematics instruction. Few studies on teacher caring have empirically examined how student-teacher relationships develop in the classroom, and even less work has theorized about how teachers do this with a group of students.

For example, Noddings (1992) describes how a teacher's classroom curriculum should center on themes of care, but she does not explicitly address how teachers build relationships with students through instruction. Likewise, Hackenberg's (2010) model of mathematical caring relations was situated between herself and a pair of students, leaving her to wonder, "in more classroom-like settings, how does a teacher work to influence students' subjective vitality while aiming for mathematical learning?" (p. 267). The discussion below aims to provide insight into this question.

The analysis of this chapter is guided by the following research questions:

- How does an integrated caring approach influence a teacher's mathematics instruction in one fourth-grade classroom?
    - What caring practices evolve from an integrated caring approach to mathematics instruction?
    - In what ways do these practices open up mathematical opportunities to learn?

Relevant Literature

Research in the field of mathematics education reveals that the instructional practices students engage with in the classroom play a central role in shaping students' views of the discipline and their emerging identities and dispositions (Boaler, 1998; Boaler & Greeno, 2000; Gresalfi, 2009). Drawing from Holland and colleagues' (1998) notion of *figured worlds*, Boaler and Greeno (2000) argue that mathematics classrooms are negotiated social spaces and construct a particular vision of what it means to be a mathematically competent learner. Findings from their study revealed that students in "narrow and ritualistic" (p. 171) mathematics classrooms reported more negative views of mathematics due to their positioning as "passive receivers of knowledge" (p. 181) whereas students in discussion-focused mathematics classrooms positively identified with the discipline. Of particular significance, Boaler and Greeno argue that teachers' perceptions of what it means to "do" mathematics significantly impacts the ways in which students are positioned in the classroom.

Other scholars suggest that students must be explicitly taught how to participate and engage in mathematics activities in order to create a classroom environment for all students to productively learn mathematics together (Boaler, 2000; Cohen & Ball, 2001; Lampert, 2001). For example, Lampert suggests that one must "teach [students] new ways to think about doing mathematics and what it means to be good at mathematics" (p. 65), which is not unlike Cohen and Ball's (2001) argument that the *learning practices* students take up in the classroom matter for whether and how students learn mathematics. Classroom contexts where students are encouraged to approach learning as a collaborative enterprise and take responsibility for one another's learning are also more likely to support the development of positive mathematical identities and dispositions (Boaler, 2002).

Taken together, classroom practices fundamentally shape the ways in which students engage and participate in the classroom, and the degree to which students identify with the discipline (Gresalfi, 2009). Or as Lave and Wenger (1991) put more simply, "learning and a sense of identity are inseparable. They are the same phenomenon" (p. 115).

Data and Methods of Analysis

Two principal concerns drove this data analysis: examining how the theoretical framework of an integrated caring approach manifested itself in my mathematics instruction, and how the enactments of care that emerged from my teaching supported student mathematics learning, with particular respect to their classroom participation and developing dispositions.

Data Sources

The primary sources of data I relied on for the analysis of my mathematics instruction were my teacher reflective journal, classroom mathematics lessons, and to a lesser degree, lesson plans and student artifacts. Specifically, my teacher-reflective journal provided me with full access to my own intentions during the intervention and provided evidence of the ways in which I strived to “establish a climate of receptivity” (Noddings, 1996, p. 22) with individual students and with the collective class. Triangulating my teacher-reflective journal with my lesson transcripts allowed me to make meaning of my pedagogical moves and instructional decision-making as I worked “from the inside” (Ball, 2000). Taken together, these data sources enabled me to examine how caring manifested itself in my mathematics instruction.

Recall from Chapter 4 that I taught all subjects within the elementary school curriculum, therefore, the work of building productive student-teacher relationships in the discipline of mathematics was situated within the broader context of the fourth-grade classroom. Therefore, it is important to note here that while I primarily speak about the ways caring manifested itself in my mathematics instruction, when relevant, I trace out from my mathematics lessons and extend my analytic lens to examine aspects of the broader classroom context, particularly in relation to the caring theme of “building a sense of community”. I describe this analytic process in further detail below.

Analytic Method

I began the coding process by first turning to my teacher-reflective journal and reading through all 42 transcribed journal entries in chronological order. Doing this several months after the ending of the intervention allowed me to "re-live" my teaching experience with the fourth-grade class but from the distanced perspective of a researcher rather than the immediate perspective of the teacher reflecting on her lessons. Here, I engaged in a process of "pre-coding" (Saldaña, 2009), where I flagged, highlighted, or underlined particular words and phrases that seemed important to attend to, which supported me in identifying regularities and patterns in my journal entries, specifically, "certain words, phrases, patterns of behavior, subject's ways of thinking, and events [that] repeat and stand out" (Bogdan & Biklin, 1982, p. 166). However, the aim of this first pass through my teacher-reflective journal was mainly to develop a conceptual understanding of my teaching experience. During this pass, I also made note of particular classroom incidents that seemed potentially important to attend to for later retrieval and more intensive analysis in subsequent iterations.

During my second pass through my teacher-reflective journal, I approached the coding process both deductively and inductively. I initially drew on the three dimensions of personal, mathematical, and political care as an analytic framework to code data, however I quickly found that, in line with the integrated nature of ICA, data examples could potentially fit under all three categories of care. As an example, I present the following piece of data from my reflective journal:

> Dude shared his idea out loud first and began by saying something like, 'I'm not sure if this is right or not, but…' and I made sure to compliment him on his willingness to share and used it as an opportunity to broaden what it meant to do math and help kids see that doing math is not about getting the answer correct, but

> explaining the reasoning behind your answer. (Reflective Journal, January 7, 2013)

When using ICA as an analytic framework, this pedagogical move of praising students for modeling a particular way of participating (which was eventually coded as "focused praise" under the broader category of "making participatory expectations explicit") could potentially be coded under all three dimensions of care because it reflected my desire to establish an interpersonal connection with Dude (e.g., personal care), make explicit to the other students they were expected to participate in mathematics activities by sharing their uncertain ideas (e.g., political care), and teach students how to engage with the mathematics in more substantial ways by explaining their reasoning (e.g., mathematical care).

Therefore, using ICA as an analytic "touchstone", I moved down a grain-size and generated a list of key practices I had theoretically identified as reflecting an integrated caring approach (i.e., use of open-ended mathematical task, checking in with individual students, expressing encouragement, assigning mathematical competence, etc.) and used these practices in my initial coding. I also developed in-vivo codes (Corbin & Strauss, 2008) as I read through the journal entries and added these to the list of identified codes. As such, the list of generated codes that emerged from the second analytic pass through my reflective journal represented a combination of a priori and emergent codes. At this point, I began sorting and grouping similar data examples together, or to use Tesch's (1990) terms, decontextualizing and recontextualizing the data to develop "pools of meaning". This process also allowed me to strategically reduce the data from my teacher-reflective journal into manageable chunks.

Based on the preliminary categories developed through my two passes through my teacher-reflective journal, I established an initial framework, which was used to code a selected sub-sample of 12 transcribed classroom lessons. I chose one lesson from each week of the intervention (recall that I did not receive institutional review approval to audio-record lessons until the third week of the intervention), and two additional lessons in which I had identified a “critical moment” occurring based on my teacher-reflective journal (critical moments also occurred within the other 10 lessons). I reasoned that selecting 12 lessons allowed for the analysis of a manageable size of lessons while still allowing for adequate variation at different time points throughout the intervention. During this analysis, categories and subcategories were reorganized and added, in particular, to make space for data examples from my lessons that did not fit the categories of the initial framework developed from my teacher-reflective journal.

My final pass through the two data sources had several purposes: to test the categories developed in the coding framework to ensure that I had sufficiently captured the data, to compare data examples within and between categories to further develop the properties and dimensions of each category (Corbin & Strauss, 2008), and to bring the analysis to an interpretive level of hypothesis (Coffey & Atkinson, 1996) by arranging these categories into conceptual themes to answer my research questions of how care manifested itself in my mathematics practice, how these practices served as enactments of care to enable the formation of pedagogical relationships, and how these relationships supported student mathematics learning.

Taken together, the analytic process described above led to the emergence of four caring practices and related instructional strategies (See Appendix E for coding framework). As I noted earlier, the caring practice of "building a sense of community" related to the broader classroom context of the fourth-grade classroom, therefore, once this practice was established, I pulled from other sources outside of the discipline of mathematics (e.g., daily lesson plans, classroom activities, and student work) to develop this caring theme further. This practice, as well as the fourth practice of "Creating Micro-opportunities to Learn" deals more generally with the overall teaching and learning experience and applies across subject areas more than the first two practices.

Table 1. Four caring practices and related instructional strategies

Making Mathematics Accessible
• Facilitating task launch
• Making participatory expectations explicit
• Mitigating social risks of participation
Redefining What it Means to Learn Mathematics
• Promoting sense-making and reasoning
• Distributing mathematical authority
• Assigning competence
• Making explicit statements
Building a Sense of Community
• Implementing a curriculum of empathy
• Establishing classroom rituals
• Facilitating dialogue
• Spending time together
Creating Micro-opportunities to Learn
• Confirming students
• Selective seating

Two additional points are important to keep in mind: first, throughout the process described above, I wrote analytic memos as a "code- and category-generating method" (Saldaña, 2009, p. 216) to keep track of emerging patterns, "open up" the data, make linkages across concepts and categories, and to begin to conceptualize a story line and "move the research from raw data to findings" (Corbin & Strauss, 2008, p. 123). Second, the analytic procedure I undertook and the construction of the coding framework was far less tidy and more unwieldy than I describe above. I have attempted to impose order and make visible the ways I went about developing the coding framework, however, in truth, the conceptual lines I have drawn between the phases of analysis are somewhat artificial. That is, I went back and forth with my data examples multiple times, organizing and reorganizing categories, and moments of insight and perplexity (and frustration!) occurred throughout the analytic process.

Findings

Based on my analysis, four caring practices emerged in my mathematics instruction from an integrated caring approach (see Figure 2):

1. Making mathematics accessible
2. Redefining what it means to learn mathematics
3. Building a sense of community
4. Creating micro-opportunities to learn

As a set, the instructional strategies listed under each conceptual practice reflect the specific ways that caring practice manifested itself in my mathematics instruction. These caring practices and related strategies reflect patterned ways of interacting with students across the 12 week teaching intervention and are summarized in Table 1. Below, I present each caring practice and related strategies to provide an image of how the students and I interacted across the intervention.

To be clear, I am not claiming the practices and instructional strategies that emerged from an integrated caring approach in this classroom are new practices. Rather, because this study is viewed from the theoretical lens of care, I build on, synthesize and ultimately reorganize prior research in mathematics education to identify ways teachers can build productive working relationships with their students and enable student learning through their mathematics instruction.

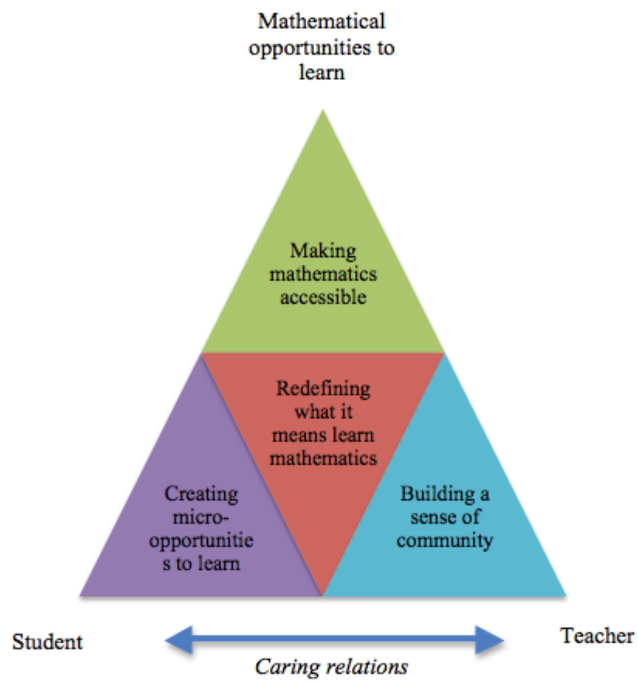

Figure 2. Four caring practices evolving from an Integrated Caring Approach

One final note, because the process of caring is grounded in a sense of responsiveness to another, my pedagogical choices were necessarily influenced by my interpretations of the classroom context and who *these* fourth-grade students were. Put simply, caring practices are *not* value-neutral. Rather, they are guided by one's personal and professional experiences, how one sees their students, and what one thinks is important for students to learn and be able to do in order to be successful in learning mathematics, in the classroom writ large, and in society more broadly. My larger point is to explain why ICA is not a technical approach to teaching nor should the practices presented in the following chapter be viewed as prescriptive. As Erickson (2004) points out, "local practice is ultimately inimitable, necessarily reinvented locally in each new occasion of practice" (p. 508), and the classroom dynamics and the identities of the individuals in *this* fourth grade classroom both shaped and impelled the relationship-building path the students and I took during the intervention.

Making Mathematics Accessible

The first caring practice present in my mathematics instruction was how I strived to make the mathematics accessible for students in order to encourage their classroom participation. Three instructional strategies I employed were *facilitating the task launch*, *making participatory expectations explicit*, and *mitigating the risks of participating*.

Facilitating task launch. A central aspect of ambitious mathematics instruction is the first phase of the lesson when the mathematical task is introduced to the class. The set up of the task, or how the task is "launched", potentially enables students to engage more productively with the mathematics in the problem (Boaler, 2002). Jackson and Cobb (2010) specify that two features of the task must be addressed during the task launch to ensure mathematics instruction is *equitable* as well as ambitious: first, surfacing implicit suppositions in the task scenario that may be unfamiliar to students; and second, ensuring students have an understanding of the mathematical relationships described in the task. They argue that having access to these two aspects will support all students' "substantial" (p.17) participation throughout the mathematics lesson.

Ensuring that students understood the contextual features and key mathematical relationships within the task were therefore important instructional goals to attend to during the introductory discussions of our lessons. The lesson segment I provided in

Chapter 5 illustrating the class discussion around the mathematical task related to Dude's kindergarten question provides one example of an introductory discussion aimed to enable students to substantively engage with the problem. Another instance of this can be seen in the introductory discussion around the following multiplicative comparison problem:

> *Anthony's secret number is 4 times as large as Carol's. What could Anthony's secret number be? What could Carol's number be?*

One goal for the set up of this mathematical task was to open up and emphasize the multiplicative relationship represented in the problem (e.g., Anthony's number was four times as much as Carol's) to support students in understanding that discovering Anthony's number was dependent on knowing Carol's number and vice versa. Because there was not a task scenario per se, I was interested in hearing how the students conceived of the mathematical relationship presented in the problem. Therefore, unlike the problem described in Chapter 5, unpacking the problem context was less important during this task launch, yet listening to students' initial ideas and how they were reasoning mathematically would support me in knowing whether a more detailed unpacking of the mathematical situation was necessary.

After Justin read the problem out loud, I called on Kamari to explain the mathematical relationship between the two numbers:

> Kamari: You're gonna need a number. All it tells you is that Anthony's number is four times more than Carol's.
>
> NT: Why are you going to need a number?
>
> Kamari: Because Anthony's number is bigger – it's larger than Carol's.
>
> NT: So it sounds like you notice that Anthony's number and Carol's number are related to one another. That Anthony's number is four times as big as Carol's. Is

there another way we could describe how Anthony and Carol's numbers are related? Jewel?

> Jewel: You could also say that Carol's secret number is four times smaller than Anthony's.
>
> NT: Why? Why four times smaller?
>
> Jewel: Because if Anthony's number is four times bigger…well, Carol's has to be littler.
>
> NT: Okay, good reasoning. So, Kamari and Jewel described the same situation in the problem in two ways. Kamari said that Anthony's number is four times bigger than Carol's, and Jewel said that Carol's number is four times smaller than Anthony's. But either way, the relationship between the two numbers…um, the way they're related to one another is the same. Talk to your partner for a minute about why we can describe the problem Kamari's way or Jewel's way. (Lesson Transcript, February 22, 2013)

In the lesson segment above, I called on more than one student to describe the key mathematical ideas without hinting at a particular method or procedure to solve the task. I used intentional redundancy (Sleep, 2012) to make connections between and funnel students' ideas towards the relationship between Carol and Anthony's numbers (e.g., "is there another way we could describe how Anthony and Carol's numbers are related?"). I also explicitly encouraged students to unpack the problem situation to one another before attempting to solve the task (e.g., "talk to your partner for a minute…"). Taken together, these instructional moves were aimed to provide students with access to the central mathematical ideas in the task to engage with the problem in meaningful and equitable ways (Jackson & Cobb, 2010).

Making participatory expectations explicit. Research on equitable mathematics practices indicates that implicit norms in the classroom may be novel to particular groups of students and unintentionally marginalize student participation (e.g., Boaler & Staples, 2008; Delpit 1995; Murrell, 1994). Therefore, a second instructional strategy that aimed to make the mathematics accessible for all students was making participatory expectations explicit during instruction.

One way I strived to do this was through the use of focused praise, that is, using praise as a tool to explicitly teach students how to participate in learning mathematics. Focused praise was designed to affirm and encourage particular students, while also providing other students with a model of what it looked like to participate during mathematical activities. For example, during a geometry lesson on lines, Jordan observed the two lines intersected in such a way that an obtuse angle was formed. To draw attention to the importance of making connections between mathematical concepts, I responded with, “That’s a nice connection, Jordan. I like how you are making connections and thinking about the relationship between lines and angles”. In a different lesson, Libby began her comment with, “Emanuel said that Line AB and Line AC share a common endpoint”, and I offered her focused praise by saying, “Great way of using Emanuel’s idea as a way of pushing your thinking forward, Libby”. Highlighting how she used Emanuel’s contribution earlier in the lesson as a mathematical springboard for her own ideas was a way to praise Libby and illustrate for the class the particular ways learners engaged in the learning and doing of mathematics.

Other times, I used focused praise to make the social aspects of participating in mathematical discussions transparent. In early January, to support students in understanding that listening to other students’ mathematical ideas was an important aspect of learning mathematics, I praised Lacie for “being an attentive audience as David is sharing his idea at the board”. In another instance, Dude suggested Jewel “might be a little bit mixed up" when she identified 4 as a factor of 90. I praised him for providing an example of "a wonderful way of disagreeing with Jewel's idea respectfully" to emphasize the importance of critiquing someone's mathematical idea politely.

An additional way I made participatory expectations explicit in the classroom was by taking on a coaching role and offering students feedback and in-the-moment reminders of how to participate during lessons. For example, I prodded students to "turn your body and face your audience, not me", or "turn your volume all the way up so the kids in the back can hear you" when they were presenting their ideas at the board. Other times, I supported students in making their thinking more explicit to others by encouraging them to "point to which line you're referring to so we can connect it to what you're saying". These comments aimed to concurrently emphasize ways for students to participate and to whom they were mathematically accountable to in the classroom (Cobb et al., 2001).

Mitigating social risks of participation. Lampert (2001) acknowledges that affective aspects of mathematics learning can complicate the instructional goals a teacher holds for her students. That is:

> The fragility of individual identity in the school context is a problem for the teacher because it can get in the way of improving academic performance…if a student is unable to feel that it is safe to have and express ideas, or even to answer a simple question, then performance will not be improved. (p. 267)

Seen this way, supporting student learning involves not only making resources available for students but also *decreasing* existing obstacles that make students feel "unable" to participate in the classroom. Therefore, I incorporated particular instructional strategies designed to mitigate students' perceived risk of participating in whole-class discussions in order to allow students greater access to the mathematics.

One way I supported students in overcoming their hesitation to participate was through the invented strategy of "microphone". This strategy initially came about as a way to sustain the engagement of students in the back of the classroom when they had difficulty hearing the strategies being presented in the front from students with quiet voices. In these instances, if I noticed the restlessness of the students in the back, I would act as students' microphones and revoice their ideas (Enyedy et al., 2008) loudly enough for the entire class to hear. Other times, I drew on this strategy to encourage reluctant strategy-sharers to participate. For example, I leveraged the microphone strategy as a tool to encourage Leena, who had been a less visible participant thus far during the intervention. I noted in my journal that:

> I asked Leena if she would put her representation up for the class to see, and she said she would but she didn't want to have to explain her idea, so I asked if I could be her microphone and she said that was fine. So, she went up and drew her model and then sat back down, and I explained her idea for her. This was one way of engaging her – a start, I think. (Reflective Journal, January 14, 2013)

I did not explicitly teach the microphone strategy to the class, but other students eventually recognized it as a resource they could utilize to support their participation:

> Cindy asked me to be her microphone when she was standing up front sharing her explanation. I thought that was really cute because I've never explicitly taught [the microphone strategy] to the kids. I must have used it often enough with the other kids that she sees it as a resource of some sort. She turned to me and asked if I would be her "microphone" instead, so she whispered to me what to say and I would say it [to the class]. (Reflective Journal, January 30, 2013)

Having Cindy whisper her ideas to me so I could echo them back to the class was not the most efficient strategy from an instructional standpoint. However, doing this allowed Cindy to retain ownership of her mathematical ideas and participate in a central, yet less risky way. In addition, projecting her ideas loudly enough for the students in the back to hear was a strategic move on my part to keep them engaged in the discussion. It is relevant to mention that Cindy appeared to become more comfortable participating in front of the class on her own and did not use me as a microphone in this way again during the intervention.

Two other strategies that aimed to mitigate student risk of were encouraging quick rehearsals between students before their public presentations in front of the class and using a “strength-in-numbers” approach. For example, after identifying particular mathematical strategies during the student exploration phase of the lesson that I wanted to facilitate a discussion around in the whole-class discussion, I encouraged some students, particularly those I recognized to be shy or reluctant, to rehearse their explanations with their partners as a way to decrease the anxiety associated with public aspects of strategy-sharing. In addition, the knowledge I gained from students during our interviews was particularly useful in supporting their participation:

> I had Dude and Sirenity come up [to the board] together because I knew Sirenity would not go on her own. I think it makes them feel braver, and I purposely told them to stay up there…while Jewel was sharing her idea because I remember how she said during our interview that she gets nervous when she’s up there by herself. (Reflective Journal, January 16, 2013)

In this way, leveraging my growing knowledge of individual students allowed me to position them in ways that would make them more likely to participate.

Redefining What it Means to Learn Mathematics

I briefly mentioned in Chapter 5 how the fourth-grade students collectively held traditional conceptions of what it meant to do and learn mathematics related to speed, accuracy, and numbers and operations. In order to move towards the instructional goals reflected in an integrated caring approach, it was important to expand student conceptions of the discipline and what it meant to be mathematically competent. Therefore, the second caring practice reflected in my instruction was redefining what it meant to learn mathematics. Four instructional strategies related to this theme involved: *promoting mathematical sense making and reasoning*, *distributing mathematical authority*, *assigning competence,* and *making explicit statements*.

Promoting mathematical sense making and reasoning. The mathematical tasks students engaged with throughout the intervention aimed to provide students with opportunities to engage in mathematical sense making and reasoning. From the lens of an integrated caring approach, tasks[9] were chosen to harmonize with students' mathematical ways of thinking (Hackenberg, 2010) and enable productive interpersonal interactions between student and teacher (Goldstein, 1999), namely by choosing tasks that afforded students with the opportunity for "productive struggle" (Merseth, n.d.).

Engaging with open-ended mathematical tasks that offered multiple solution pathways throughout the intervention appeared to destabilize students' views of the discipline. One lesson in mid-January seemed particularly instrumental in problematizing student conceptions that only one correct answer existed for every mathematics problem. In the lesson segment presented, the students were working on the following task:

> *I sat down to watch TV and when I looked up at the clock, I noticed that the hands of the clock made an obtuse angle. What show might I be watching? What time might it be?*

Thus far during the intervention, the fourth-grade students had engaged with mathematical tasks in which they could approach the problem in multiple ways. This task was the first problem where it was possible for multiple *solutions* to be generated.

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[9] See Chapter 4 for a detailed explanation of how an integrated caring approach influenced my choice of mathematical tasks.

Immediately prior to the interaction described below, the students and I had come to the agreement that the hands of the clock had to form an angle greater than 90 degrees. We also agreed that while many different solutions were possible, all solutions were not possible because there were a limited number of ways the hands of the clock could be arranged to form an obtuse angle. However, the idea that there could be more than one correct answer to the problem appeared to throw some students for a loop. In the lesson segment I present below, one student, David, struggled to make sense of this:

> NT: David, do you need something clarified?
>
> David: Yes. I know it can't be any old time, but there are, like, so many obtuse angles that I don't really know what kind of an obtuse angle. An obtuse angle like this? [Gesturing with hands] An obtuse angle going like that? [Gesturing with hands] It could be lots of obtuse angles.
>
> NT: So what I hear you saying, David, is that you recognize that the hands of a clock can form more than one obtuse angle. Is that right?
>
> David: Yes.
>
> NT: So could some of our clocks look different?
>
> Unidentified student: Maybe.
>
> David: But I still don't get it.
>
> NT: Okay, try again for me. What do you not get?
>
> David: What I do not get is, why, how do we…figure out which obtuse angle is the right angle of the problem?
>
> NT: Well, do you think there is only one possible time the hands of the clock could be pointing to?
>
> David: No. I think there is [*sic*] so many of them. I think there is more than one time. I think we could do it a lot of ways, but if we all get, if we don't know… I'm just saying, there could be many obtuse angles. I know what an obtuse angle is, but there is only one thing I don't get about it. It's that we could do it any way, but we could do an obtuse angle any way, but we can't…we can't, can't know which numbers of the clock we have to put it to. That's, that's what I don't know.

In this exchange, David identified that he had developed an understanding of the key mathematical ideas of the problem (e.g., “I know it can’t be any old time”, “I know what an obtuse angle is”), but he wanted to know which answer was correct (e.g., “What I do not get is, why, how, do we…figure out which obtuse angle is the *right* angle of the problem?”). In this response, David was using the term “right” to mean *correct*, and not referring to a 90 degree angle. This was not immediately clear to me, but became evident as our interactions continued below. What I was hearing in David’s questions was a sense of disequilibrium, namely that while he recognized it was possible to arrange the hands of the clock in multiple ways (e.g., “there are like so many obtuse angles”, “I think there is more than one time”), he was also struggling to come to terms with the fact that more than one answer could be correct as evidenced by his comment “we…can’t know which numbers of the clock we have to put it to”.

As illustrated above, I struggled with decentering from my way of thinking mathematically (e.g., “Okay, try again for me. What do you not get?”) (Hackenberg, 2010). From my perspective, we had sufficiently clarified the problem space during the task launch (e.g., many different solutions are possible, however the hands must form an obtuse triangle so all solutions are not possible), and my attempt to support David in reconciling these two competing notions (e.g., “So could some of our clocks look different?”) was unsuccessful. I could sense David was growing frustrated because he was not being understood. At this point, I was unsure of how to proceed so I invited other students to interpret and respond to David’s question for me:

> NT: I’m having a hard time understanding David’s question. Does anyone have a sense of what David is trying to say and want to explain it to me? Jewel?

> Jewel: He doesn't get, um, if you have one answer, and somebody else has another one, which one is right. Is that it?
>
> David: No. [Louder] That's not what I'm saying at all. I'm saying that you could do it any way, but you have to do it an *obtuse* way, not a right angle or an acute angle. Cindy, do you know what I'm saying?
>
> Cindy: Yeah. You're trying to say that, like, which numbers is it going to be that is the obtuse angle.
>
> David: Yeah, like, which obtuse angle is going to be the right way?
>
> Cindy: Yeah yeah. Like, which one is the right one.
>
> NT: When you say "right", do you mean correct?
>
> David: Yes, the correct way to put the obtuse angle.
>
> NT: Well, I wonder if there is…Here is the question I want you to think about, and then I'm going to have you guys get started. I wonder if there is more than one correct way to do this problem. Or is there only one correct way? I don't know. So, David, let's hold your question for now, and we'll come back to it when we share our solutions. I think this is a really great question for you all to be thinking about. Thank you to the three of you for trying to clarify that for me. (Lesson Transcript, January 23, 2013)

I could sense that David (and likely others) craved more guidance, however, I did not resolve David's tensions at this point during this discussion but instead tried to provoke the class to consider his question as they were solving the problem (e.g., "I wonder if there is more than one way to do this problem"). During our whole-class discussion following students' exploration of the task, several students shared multiple solutions, and we agreed there was more than one "right" answer to this problem. Like David, Lacie's journal entry that day revealed she was also coming to terms with the idea that it was possible for there to be more than one correct answer to a mathematics problem. She wrote:

> Today in math I learned that in some problems we can have more than 1 ancser [*sic*]. I do not anderstand [*sic*] how that is posable [*sic*]. (Student Journal, January 23, 2013)

Another way of promoting student sense making was by consistently pressing students to elaborate on their answers to a mathematical task (Franke et al., 2009). Asking students to describe *how* they solved a problem and *why* they used a particular strategy or approach (Lampert, 2001) provided students with opportunities to engage in mathematical reasoning and develop their communication skills. I prodded students to explain their thinking by asking them to "talk us through what you just did up here" or elaborate on their explanations and "tell me more". Over time, students appeared to see providing mathematical explanations as a classroom norm (McClain & Cobb, 2001). I noted this shift in my reflective journal:

> I think some of the kids are beginning to understand that explaining your thinking is part of what it means to do math. Libby shared her reasoning without my having to follow up with her today, and Sofiya looked at me after she drew her representation at the board and asked me if she was supposed to explain why. (Reflective Journal, January 8, 2013)

Pressing students to provide mathematical explanations was aimed to support students to attend to their reasoning and whether or not their approach made sense. In addition, it was also a way to encourage students to see sense making as a marker of mathematical competence, and not whether or not one got the answer correct.

A final way I promoted learning mathematics as a process of sense making was by negotiating district assessments to provide students with opportunities to engage with more mathematically substantive problems. Specifically, I chose to assess student learning using the short-answer mathematics assessment instead of the multiple-choice assessment provided through the district curriculum. The district curriculum provided teachers with two assessment options: a 10-15 question short-answer assessment which was more closely aligned with the problem-solving tasks students had been engaging with through the intervention, or a 30-35 answer multiple-choice assessment aimed primarily at assessing students' procedural knowledge. Because it aligned with the format of the district benchmarks and end-of-year state assessment, the district administrators encouraged teachers to use the multiple-choice version, and the fourth-grade students were accustomed to taking it.

I administered the multiple-choice assessment after my first month of teaching, but I was not pleased:

> I'm frustrated with that multiple-choice assessment. It has its benefits, mostly in terms of grading because you can scan students' answer sheets in like 10 minutes and get the results right away. But, overall the kids did not do well, and there's no room to give them partial credit because their thinking isn't visible for the most part. And I hate the message I'm sending [students] by giving them this assessment. We've been working to see sense making and reasoning and explaining as part of what it means to do math, and this assessment just so does not represent any of those things. (Reflective Journal, December 20, 2012)

As revealed in my journal entry, my choice to switch to the short-answer assessment was motivated for several reasons: students' low performance as measured by the multiple-choice assessment, how little information the assessment provided me to guide my instruction, and an overall concern that administering an assessment that, in my view, provided little opportunity for students to engage in mathematical sense making was sending a contradictory and harmful message about what was important and valued when doing mathematics. To ease this tension, I assessed students using the short-answer assessment for the remainder of the intervention, and this choice was a small way for me to negotiate "the politics of school testing" (Gutiérrez, 2013, p. 8).

Distributing mathematical authority. Another way to support students in redefining their views of the discipline was through the instructional strategy of distributing mathematical authority. As Gresalfi and Cobb (2006) articulate:

> Authority concerns the degree to which students are given opportunities to be involved in decision making and whether they have a say in establishing priorities in task completion, method, or pace of learning. Thus authority is not about "who's in charge" in terms of classroom management but "who's in charge" in terms of making mathematical contributions. (p. 51)

By sharing authority among all members of the classroom, my goal was to support students in seeing one another as valuable intellectual resources to draw on and problematize the notion of the teacher as the primary source of mathematical knowledge.

In early January, I noted in my journal:

> So many of them want me to be…the ultimate decision maker and authority on whether or not they're doing it the right way or if the answer is right. I want them to start trusting themselves more, give it a shot on their own, and start seeing their colleagues as valuable resources to draw on. (Reflective Journal, January 8, 2013)

Therefore, one way I distributed mathematical authority in the classroom was by facilitating or maintaining interactions between students. For example, when students were uncertain about their ideas, I encouraged them to "call on a colleague" and, in another example, when Leena called me over and shared that she and Emanuel did not come up with the same answer, I encouraged her to "convince him" why her idea worked. Inspired by Lampert's (2001) work, I established the classroom norm where students were obligated to ask two colleagues for assistance before asking me. My intention here was to enable student-to-student interactions and increase students' intellectual autonomy. Taken together, these actions aimed to position students to begin to see one another as mathematical resources and deepen their mathematical understandings by explaining their reasoning to each other.

Other times, I made references to what “a mathematician would say” in an attempt to defer my role as the mathematical authority in the classroom. For example, when Kamari and Emanuel were negotiating the difference between a polyhedron and a net during a lesson in January, I explained to the class that “a mathematician would say that a net is a two-dimensional representation of a solid figure” to sidestep being the authority to verify which definition was correct.

As noted previously, the notion of mathematical authority “is not about “who’s in charge” in terms of classroom management but “who’s in charge” in terms of making mathematical contributions” (Gresalfi & Cobb, 2006, p. 51). While this distinction was pedagogically clear in my head, this invisible line appeared to be less clear for some of the fourth-grade students. That is, all students did not readily take up classroom opportunities for them to develop and use their own mathematical authority, and it is possible their hesitance was linked to their perception of me as an institutional authority of the school, specifically an adult from whom they should listen to and take direction from.

My interactions with Colin during one lesson led me to wonder if my attempts to share mathematical authority among the students conflicted with his vision of “who’s in charge” in a classroom. To provide context, recall that Colin was the boy I sat next to in the back of the room during my classroom observations prior to the start of the teaching intervention[10]. Sitting quietly for periods of time was not Colin’s strength; that is, he struggled with “playing school”, and unstructured times during the school day could be particularly challenging for him. In the classroom, I found that engaging Colin in

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[10] Refer to “Classroom configuration” section in Chapter 4 for our initial interaction.

classroom discussions, checking in with him, or standing close to him throughout the day were useful methods of funneling his energy. This is not to say these strategies were always successful, but rather to indicate that Colin rarely acted in a defiant manner and tried to fall in line with what it meant to be a student at school.

In the lesson segment below, I opened up space for students to take on a more central participatory role during the discussion:

> NT: Who wants to explain to Lacie why they think 3/6 is the same as 1/2?
>
> [Silence]
>
> NT: Who wants to clarify why they think 3/6 and 1/2 are equivalent?
>
> [Silence]
>
> NT: Unless you all think they're not equivalent?
>
> Ss: No, they're the same!
>
> NT: Well, then we gotta figure out why, right? Why are the two fractions equivalent? I mean, just because I say they are doesn't make it true.
>
> C: But maybe it should? (Lesson Transcript, February 4, 2013)

It is difficult to capture here the hesitancy and questioning tone in Colin's voice as he made this comment. And because this piece of the interaction comes from an audio-recorded transcript, his facial expression and body language were not captured, either. However, I described my impressions of him in my reflective journal that day:

> When Colin said that comment, he sort of cocked his head and shrugged his shoulders at the same time. And that look he gave me... He didn't finish his sentence but when he sort of trailed off, it felt like he wanted to say something like, "Well, maybe it should be true because you're the teacher!". There's something about that interaction that is just sticking with me. Maybe it's because I've never really thought about what a weird thing this mathematical authority thing might be from the kid's point of view. (Reflective Journal, February 4, 2013)

I did not interview Colin about that moment, and it is not possible to make strong claims about what he meant. But when considered against the backdrop of who I knew Colin to be at school – a boy who was eager to please, yet struggled with school disciplinary issues – one possible interpretation is that Colin had constructed a particular vision of what a student-teacher relationship should look like in the classroom across his schooling experiences, and the idea of shared authority between student and teacher during a mathematics lesson was puzzling. Therefore, to return to our classroom exchange during the mathematics discussion, perhaps in Colin's eyes, a fraction should be equivalent simply because the teacher said so. It also seems relevant to point out that Colin rattled off the phrases, "paying attention, staying in your seat, following along, [and] never talking" (Interview 1, January 8, 2013) when I asked him to describe his conception of a good mathematics learner.

Assigning competence. Redefining students' conceptions of what it meant to learn mathematics also necessitated reconstructing their views of mathematical competence, and I drew on the instructional strategy of assigning competence (Boaler & Staples, 2008) to establish a new vision of what it meant to be a good mathematics learner. Specifically, assigning competence involves:

> raising the status of students that may be of lower status in a group, by, for example, praising something they have said or done that has intellectual value, and bringing it to the group's attention; asking a student to present an idea; or publicly praising a students' work in a whole class setting. (p. 632)

Because publicly recognizing and affirming the contributions of specific students reduces status differences within the classroom, assigning competence can also be viewed as a form of *relational equity* (Boaler, 2002).

As the intervention progressed, I developed a sense of the student social hierarchy that existed within the fourth-grade class and gained insight into which students appeared to hold more social power than others. For example, I made frequent attempts to assign competence to Lacie, a socially isolated student, who was often teased or ignored by other students. Specifically, I would ask her to come to the board to share her mathematical strategies or praise her “wonderful ideas”. In the earlier example of the obtuse angle problem, it was Lacie who honed in on the key idea that the hands of the clock had to form an angle greater than 90 degrees during the task launch, and my comment of, “Think about what Lacie is saying here. She’s saying that it’s important to pay attention to where the hands of the clock are pointing” was designed to assign competence to both Lacie and her mathematical idea.

Other times, I employed the discursive tool of revoicing (Enyedy et al., 2008) to assign competence to particular students, mainly students who were English language learners or quiet thinkers. Drawing from Forman and Ansell (2002), Enyedy and colleagues define revoicing as “an epistemic device that shares the intellectual authority with the students and helps establish their role as one of contributing to the construction of knowledge ” (p. 137), and revoicing allowed me to involve more students during classroom discussions. The student exploration phase of the lesson, in particular, served as a time to gather the ideas of students who were less visible participants for the purposes of putting their ideas out for discussion during the whole-class discussions. Assigning competence to these students took forethought and pre-planning, otherwise it was possible to get pulled away by other students who were more vocal and actively sought me out. For example, I noted that:

> I made an attempt to head straight for Edward and Anthony today to talk with them about their ideas before I got sidelined by the others. (Reflective Journal, January 28, 2013)

Later in that same lesson, I announced to the class, “So, Anthony and Edward were saying they think each of the kids [in the problem] will only get part of a brownie and not a whole brownie. Do you want to share out what you guys were talking about?”.

I also began to develop a sense of how students saw themselves as mathematics learners over time and assigned competence to students who appeared to have less confidence in their mathematical capabilities. For example, Carol was a quiet student who rarely volunteered to participate publicly during our mathematics lessons, however, her journal entries were often revealing, and she openly shared her frustration through her writing and illustrations. Therefore, I made explicit attempts to position Carol as a valuable member of our mathematical community throughout the intervention. In one such incident, I noted in my reflective journal:

> …in [Carol’s] journal entry [yesterday], she said that didn’t know what she was doing and drew a picture of herself with a frowny face. So I made a point to show the kids her multiple attempts today at the beginning of the lesson. I saw this as a way of both positioning Carol and also as a way to highlight for the kids that making multiple attempts and trying again is a part of what it means to do math. (Reflective Journal, January 9, 2013)

Making explicit statements. A final strategy I incorporated to problematize students’ traditional views of mathematics was sprinkling explicit statements throughout mathematics lessons. For example, I was aware from student pre-survey responses and interviews that some believed that encountering mathematical struggle when solving problems indicated that one was mathematically incompetent. To counter this notion, I expressed comments such as “struggle is good for the brain – it stretches it out and makes it bigger" to encourage student engagement when I sensed some were beginning to get frustrated with challenging ideas. In another example, I encouraged students to "chew on that for a bit" to problematize the notion that being good at math meant coming up with an answer quickly. Expressions such as "I love it when we disagree about a problem because it means you all have different ways of thinking about the problem" aimed to support students in seeing the value of multiple methods and approaches and to promote respect for other viewpoints (Boaler, 2002). Other explicit comments such as "this is what mathematicians do – they discuss, they argue, they reason" provided students with a vision of learning as a "collective, rather than an individual, endeavor" (Boaler, 2002, p. 76).

Building a Sense of Community

Learning new practices and taking up new ways of participating in a classroom involves personal and intellectual risk-taking (Cohen, 2005). And Lampert (2001) also reminds us that:

> For the student, taking on the "new" self that the teacher imagines is risky, and feelings towards the teacher for encouraging such risk taking may not be wholly positive. (p. 268)

Therefore, it was important to build a sense of community within the classroom – both among students and between students and myself – and establish a learning culture that would enable students to take intellectual risks and work collaboratively and productively with one another. Four instructional strategies that reflected the caring practice of building a sense of community were *implementing a curriculum of empathy*, *classroom rituals*, *dialogue*, and *time*.

Not unimportantly, during the early weeks of the intervention, I noted in my reflective journal that the overall classroom climate was tenuous:

> Not a day has gone by so far when someone hasn't complained that so and so was mean to them. And I've noticed it myself – Isaiah intentionally knocked Jason's pencil box off his desk yesterday, Kyler is always calling someone a loser, and no one wants to be around Lacie ever. It's heartbreaking. Not even some of the kids who are generally so kind. (Reflective Journal, December 6, 2012)

The caring practice of building a sense of community was motivated by the desire to promote a sense of solidarity within the classroom (Duncan-Andrade, 2009; Bartell, 2011), support students in recognizing that learning was a collaborative experience, and that their actions in the classroom, both positive and negative, influenced one another's social and intellectual well-being. To be clear, my intention in implementing these strategies was not to "promote a rah-rah ethos or…express platitudes ('everybody belongs here')" (Yeager, Walton, & Cohen, 2013, p. 65), but rather it was an attempt to support each individual student in feeling like a valuable and unique member of the classroom community.

Implementing a curriculum of empathy. Drawing from Christensen (2000), Bartell (2011) suggests that mathematics teachers who care with awareness incorporate a "curriculum of empathy" in the classroom by designing activities that support students and teachers to "look beyond their own world and share the lives of others" (p. 60). While not explicitly related to teaching mathematics content, these activities can enable teachers to develop connections with their students across cultural lines and promote connections among students as well.

One way of developing a sense of empathy and understanding among the classroom was through the use of stories during our daily 30-minute read aloud time.

Situations that occurred in these stories provided me with opportunities to make connections between the experiences of particular characters and students' classroom experiences. One such book, *How Full is Your Bucket?: For Kids* (Rath & Reckmeyer, 2007), was recommended by a fellow teacher at the school after I shared my desire to promote positive relationships between students. Using the metaphor of an invisible bucket, this book posited that every person carries an invisible bucket over their heads, and that our own buckets are emptied or filled depending on our interactions with others. It provided concrete examples of what it looked like to "fill" or "dip into" another person's bucket, such as befriending a lonely student on the playground or recognizing a fellow student's hard work in the classroom.

The students and I also held our own discussion grounded in the ideas of the book and brainstormed actions we could do (or had done in the past) as "fillers" and "dippers". For example, Jason shared that he had once ripped another student's homework assignment in half, and Sofiya suggested that not laughing at a student when they made a mistake represented actions of being "a dipper" or "a filler", respectively. An unintentional byproduct of reading this book was that it provided students with language in which to describe their own feelings. For example, when Stephen called Lacie "an idiot" one day in class, Lacie immediately responded with, "You just dipped in my bucket!"

Two other books, *The Tale of Despereaux* (DiCamillo, 2004) and *Wonder* (Palacio, 2012) were used as tools to support students in recognizing the value of another person's perspective and how our interpretations of particular events are shaped by our individual histories and personalities. For example, *Wonder* told the story of a fifth grade boy with a facial deformity attending school for the first time. This story illustrated the importance of looking beyond initial assumptions and getting to know individuals on a personal level, developing empathy, and appreciating differences between individuals. *The Tale of Despereaux* provided an opportunity to discuss how partnerships can form between unlikely allies, in this case, a princess and a mouse, and that the expectations that others hold for us can sometimes run counter to who we see ourselves as (e.g., mice should eat, not read books; prefer the dark over the light; run from humans instead of befriending them).

Importantly, both stories were told from multiple points of view, which supported my instructional goal for students to develop an appreciation of multiple ways of thinking. Each chapter in the book was told from the perspective of a different character and provided readers with the opportunity to see the same situation from multiple perspectives. These books illustrated how individuals could develop different interpretations of the same event and provided students with the opportunity to see that our own personal histories often shape our actions and interactions with one another.

A classroom writing activity called “Hello, World” gave students the opportunity to share aspects of themselves with one another and with me. Students described their personalities, what they wished others knew about them, future hopes and aspirations, and portrayed the kind of world they wanted to live in. Learning about one another and building commonalities through this activity served to enhance students’ relationships with one another and gave me insight into the individual each student was bidding to be seen as through the stories they told about themselves (Gee, 2001).

For example, I learned that Dude saw himself as a "cool" person, and while he generally felt "confident", he could also feel "nervus" [*sic*]. It was also important for him to live in a world where "everyone is diffrent [*sic*] from each other" (See Appendix F). Sirenity, an exceptionally quiet student who rarely spoke during class, indicated she did *not* in fact want to be viewed as a quiet person and "wish[ed] people told me I am not [a] qiet [*sic*] person more often". David, a sensitive and enthusiastic boy, who some of the other boys in the class teased and called a "crybaby", wrote that he wanted his colleagues to know that "I am tuf [*sic*]". Lacie, a loving and quirky girl, who was often the target of unkindness from many students in the class "want[ed] to live in a world where people like people for who we are". Similar to Lacie, Rohan's envisioned world was a place "where no one will fight and everyone will be nice".

Establishing classroom rituals. Daily classroom rituals served to build a sense of connection among the members of the classroom, and these specific rituals held meaning for those of us in Room 7. As a follow-up activity to the previously mentioned bucket-filler book (Rath & Reckmeyer, 2007) and to continue to promote a sense of community, I created a communal class bucket and encouraged students to keep track of bucket-filler interactions that occurred during the school day. During the intervention, students adopted the role of "drop watcher" and wrote notes to recognize classmates when someone filled their imaginary bucket or when they observed students filling the buckets of others. Blank drops were left in the back of the classroom near the communal bucket and available for students to use throughout the day.

Although students began by filling up the buckets of individual classmates (e.g., "Carol sat next to me at lunch", "Emanuel let me use the basketball first", etc.), over time, students began to offer drops for the collective class and connect it to academic aspects of the classroom. For example, Lacie wrote that “The class lisened [*sic*] to Colin”, (See Appendix G), and Colin noticed that “The class had a great question during read aloud” (See Appendix G). The students also began filling up my bucket as well, for example, Leena wrote that “Ms. Tseng say [*sic*] she likes my picture I drew for her. She put it on her wall”.

As a way of confirming students (Noddings, 1984), I consistently wrote two drops to different students after school each day as well, recognizing specific student actions and connecting them to student learning, for example, recognizing students for their willingness to share their strategies out loud, being an active listener, or disagreeing in respectful ways. For example, in late January, I wrote to David (See Appendix H):

> I’d like to compliment David for always being willing to revise his thinking when he is explaining something. Good learners are always open to changing their ideas!

I filled up Sirenity’s bucket (See Appendix H) when she shared an answer in front of the class one day:

> I would like to compliment Sirenity for sharing her ideas with the class with I called on her yesterday. Thank you for letting us learn from you!

To ensure I recognized every student in the class, I kept track of which students I confirmed each day. I read the submitted drops from the communal bucket each morning as students were getting settled as an attempt to set the tone of the day.

Rituals such as greeting one another with elbow bumps, recognizing student achievements through verbal cheers, and referring to one another as “colleagues” also served to build a sense of community within the classroom. Each morning, I greeted students at the door individually as they filed into the classroom, and students chose to greet me with a handshake, hug or high-five. After severe flu outbreak warnings occurred in early January, however, the students and I took to "elbow-bumping" as a way to prevent germs from spreading. This shift in morning greeting was far more popular with the students, and the "bump" made its way into our mathematics lessons as a way for students to celebrate one another's successes:

> I've been elbow bumping in the morning with the kids now instead of exchanging a handshake, hug, or high five because of the flu warnings. They seem to really like the elbow bump thing…I'm starting to see them doing it to one another now…I saw Anthony and Edward elbow bump today after they figured out the number of vertices on the cube. It's almost like it's become a Room 7 thing to do now. (Reflective Journal, January 15, 2013)

I introduced a classroom cheer called a "Whoo" (i.e., students clap twice and give an enthusiastic "Whoo!" while pumping their elbows backward) to celebrate one another's successes and as a form of recognition for individual students or for the whole class. In one example, I encouraged students to give Jason, a lower-status student who had been unwilling to share his mathematical ideas publicly thus far during the intervention, a "Whoo!" when he drew a set of intersecting lines at the board for the first time.

Finally, to support the view of the classroom as a community of learners working towards a common learning goal, I referred to the students as a group of "colleagues" after the term was introduced as a vocabulary word during a language arts lesson early on during the intervention. For example, I suggested students "draw on [their] colleagues as resources" when they were struggling with mathematical ideas or articulating an explanation. Students also took up the term on their own and began to ask if they could "call on a colleague" as a mathematical resource during mathematics discussions.

Dialogue and time. Building a sense of community also involved the practice of dialogue (Noddings, 1984) and the closely connected construct of time (Tarlow, 1996). From the lens of care, dialogue serves as the primary vehicle to establish and maintain relationships, and a recurrent theme in the literature indicates that teachers leverage the knowledge gained from dialoguing with students to strengthen learning opportunities in the classroom (Agne, 1992; Bartell, 2012; Gordon et al., 1996; Noddings, 1984).

Dialoguing with students provided me with salient knowledge of students that strengthened my pedagogical approach in multiple ways. For instance, the interviews I held with individual students both during and after the intervention provided a space for the students and me to engage in the practice of dialogue. Students shared aspects of themselves – both as individuals and mathematics learners – and their perspective of classroom activities with me in these interviews. The patterns that emerged from our dialogues led to changes in my overall classroom approach. For example, several students explained they would feel more comfortable presenting their strategies at the board in groups, therefore, I used this "strength in numbers approach" as a way to facilitate participation from hesitant students in subsequent lessons.

On a collective level, the practice of dialogue was also evidenced during a classroom discussion related to student survey responses. Inspired by Lubienski's (2000) experiences as a teacher-researcher, and her post-teaching reflection that engaging in explicit classroom discussions may have increased the participation of all students, I made the decision to share students' survey responses with the class:

> N: Thank you again for being so honest in your responses. It's really helpful information for me to know how you feel about learning math, and it gives Julie and me ideas about how best to teach you. So, one of the things I noticed as I was looking at your surveys – well, something that really stood out to me were your

> responses to the statement “I like to share my math strategy in class”. Do you remember that question?
>
> [Chorus of yeses from the class]
>
> NT: So that question was really interesting to me because a lot of you said that you only liked to share “a little bit” or “never”. And then those of you who I had a chance to talk with helped me understand why so many of you don’t seem to like sharing your ideas out loud. Does anyone want to share or expand a little bit on why you picked “never” or “a little bit”? Libby?
>
> Libby: It’s scary and you feel nervous.
>
> NT: Um-hmm, it *can* be scary. Does anyone else feel the same way as Libby? I see some of you nodding your heads. So, you know, sometimes I forget what it’s like to have to talk in front of a lot of people. I get so excited to hear your ideas and I want all of you to hear one another’s ideas, too. And I forget sometimes that it can be really scary to get up in front of the class and have to put your ideas out for everyone to hear.
>
> Colin: Stage fright. You can get stage fright.
>
> NT: So, I want to let you know that I understand why you feel that way. And I’m glad I know that because now I know that sometimes it’s not that you don’t want to participate, it’s that sometimes you’re feeling sort of nervous about it. (Lesson Transcript, January 28, 2013)

Thus far in the discussion, I used dialogue to both acknowledge and validate students’ perspectives (e.g., “thank you for being so honest in your responses”, “it can be really scary to get up in front of the class”). In addition, I forged connections between students by identifying commonalities in their mathematical experiences (e.g., “Does anyone else feel the same way as Libby?”).

However, because the goal of caring relations is to support students’ competence, I also leveraged dialogue to guide students towards new intellectual possibilities and ideas (Noddings, 1984). As I continued with the discussion, I began to move students towards my intended instructional goals:

NT: But, here's the other interesting thing, though. Are you guys ready for this? On another question, a lot of you said that listening to other students' math strategies helps you "most of the time" or "sometimes"… Do you see why I find that so interesting? On the one hand, it can be really hard for some of you to share your ideas, but on the other, you all like to…

Ss: Listen.

NT: That's right. You like to listen to how other people are thinking about math problems. So, it's sort of a dilemma. Do you know what a dilemma is? It's a problem – not necessarily a bad problem.

Emanuel: It's a good problem.

NT: Why do you think this might be a little bit of a dilemma for me? Anisa?

Anisa: It's a problem because you really don't want to hear, like, 30 students sharing different answers.

NT: Well, actually I do kinda wish I could hear 30 different ideas. Lacie?

Lacie: Maybe it's a dilemma because if all of us – lots of us don't like to share then we can't learn from one another.

NT: Yeah, that's what I was sort of thinking. It's hard to learn from one another if not a lot of people want to share their ideas out loud. And you all have such great ideas – I hear them when I'm walking around the room or when I'm looking at your work after school. So, I wanted to share the survey and my dilemma with all of you because…I know many of you have been working at participating a little bit more. I've noticed that. A lot of you are learning from one another and building off of each other's ideas. So, it's not just Julie and I [*sic*] who are teaching in this classroom, but you are also teaching and learning from one another. And I want to encourage you…you know, even if you're not sure if your answer is right, even if you just have an idea to share, share your idea with us. (Lesson Transcript, January 28, 2013)

In this part of the discussion, I shared with students the dilemma I was struggling with and, in one sense, reversed the caring roles by asking students to take on my perspective (e.g., "why do you think this might be a little bit of a dilemma for me?). I also confirmed students by acknowledging I had noticed their increased participatory efforts (e.g., "I know many of you have been working at participating a little bit more"), while also working to “stretch the student’s world” (Noddings, 1984) by encouraging them to share uncertain ideas.

Another way dialogue facilitated a sense of connection within the classroom was through the use of student journals. Specifically, these written journals provided an opportunity for students to share their individual mathematical experiences with me. For example, Sofiya shared her frustration when she did not understand Rohan and Jordan’s mathematical explanations during a lesson on obtuse angles:

> [Today in math] I did not understand when Rohan and Jordan explained their work on the clock math problem in school today. I think they didn’t explain enough because I still don’t know how they got the answer.

David’s journal entry revealed that he considered what we were learning during our math lessons against the backdrop of the upcoming district benchmark assessment:

> [This week in math] I learned how to make fracthions [*sic*] like 1/2, 3/4, and 4/4, and 1/4. It made me think more about are [*sic*] Math bencmark test.

Leena shared her enjoyment learning new mathematical ideas:

> [Today in math] I thought of defferent [*sic*] idea. I realized that I got smarter and I learned new stuff. Today I had a good time with the entire classroom!

Carol shared her frustration understanding a lesson on algebraic expressions:

> [This week in math] I didn’t understand yesterdays [*sic*] math and I don’t understand what kid [*sic*] are saying

Given the large size of the class, students’ written journal entries were a particularly useful way to get to know individual students and provided a glimpse into their classroom experiences. What is more, this information also provided me with salient knowledge to strengthen student’s learning opportunities. Specifically, “the more teachers know about their students, the more clues they can derive about the best ways in which to teach them” (Agne, 1992, p. 123), Though not a strategy per se, the construct of time undergirded our developing sense of community within the classroom. Tarlow (1996) argues that time is a "latent, necessary force underwriting all caring activities" (p. 58), and spending time together across the intervention implicitly facilitated the formation of relationships. I wrote in my journal:

> I don't know exactly when or how it happened, but somehow it feels like this shift has occurred where the class and I are bonding, for lack of a better word. It's almost like we've gotten used to one another and our interactions feel less formal. Ever since we've come back from the winter break, they feel more like "my" students, and maybe they're starting to see me as "their" teacher. (January 15, 2013)

As our time together progressed during the intervention, and I sensed the students were warming up to me, I also began feeling more comfortable sharing my own self with them as well:

> I think the students are starting to feel more comfortable with me, and we are developing a relationship together as a class. I can joke with them more and I've started sharing more about my personal life with them. (Reflective Journal, January 9, 2013)

Agne (1992) explains that, "when teachers share who they are with students, as trustworthy friends, students are likely to choose to do the same" (p. 123), and exchanging aspects of my life with students as they shared aspects of theirs may have humanized myself to them and enabled them to see other aspects of my identity beyond my teacher identity (i.e., a sister, daughter, student, runner, etc.).

Creating Micro-opportunities to Learn

Thus far, I have presented classroom practices that provided mathematical opportunities for students to learn on a collective level. However, the group of students was comprised of 34 unique individuals with a range of personalities and specific needs, and caring practices involve "adjusting or creating a teaching approach specific to a student who [is] having difficulty" (Tarlow, 1996, p. 77). To this end, the fourth caring practice to emerge from my instruction was creating micro-opportunities to learn. Specifically, I refined collective classroom opportunities to learn by leveraging my growing knowledge of student personalities and preferences through the caring practices of *confirmation* and *selective seating*, and these micro-interventions reflected my desire to be responsive to the learning needs of individual students.

Confirmation. For Noddings (1992), the concept of confirmation is a tool to "bring out the best in [others]" (p. 20). In my interpretation of the concept, confirming individual students meant noticing and affirming specific things about individual students that appeared to be a "reach" and that I recognized required extra effort on their part.

One important use of confirmation was to encourage the marginal participation of specific students. For example, Sirenity was an exceptionally shy student who rarely spoke in the classroom. She often looked like a deer caught in headlights when I posed a question to her, and sometimes would not respond either verbally or through gestures. Although I recognized her discomfort, I endeavored to find ways to support Sirenity's participation in the classroom. Therefore, I did not stop asking her questions but refined the kinds of questions I asked her to increase the likelihood that she might respond. For example, sometimes I asked her questions that could be answered with a yes or a no. Other times, if I asked her an open-ended question, I followed up by offering her the option of calling on a colleague for help after a few seconds of silence.

In mid-January, these continued efforts to support Sirenity's participation appeared to pay off. As I noted in my reflective journal, her participation was particularly memorable for me:

> When we were reviewing the homework, I called on Sirenity to give an answer – just a basic recall answer for the number of edges in the prism, and she answered! The answer was 9, and I remember this because I couldn't believe that she had answered me. This is the first time she has ever answered a question I asked her directly. Most of the time when I ask, she just stares at me and looks really uncomfortable. I purposely asked her a question where she needed to give me an answer and not an explanation because I'm just trying to get her to enter a discussion at this point…I made sure to highlight her contribution [in front of the other students], but also didn't want to make too big a deal out of it so that it would embarrass her and undo all the work of getting her to the point where she would speak out loud. Big victory for Sirenity! I think I'll write her a drop in the bucket. (Reflective Journal, January 16, 2013)

In this example, I confirmed Sirenity for the individual she was bidding to be seen as (i.e., a student who did not want to participate) by not forcing her to participate, but strived to enhance her competence in her "own experienced world" (Noddings, 1984, p. 178) by continuing to offer her opportunities to participate which, over time, she did eventually take up. From an outsider's perspective, Sirenity's participation that day would not have been particularly noteworthy. However, because of *who* I knew Sirenity to be, her participation that day *was* noteworthy. Writing her a drop in the bucket, as I indicated in my journal entry, was an additional way for Sirenity to know I recognized and appreciated her attempt to push herself outside of her comfort zone.

Confirmation was also used as a tool to encourage the development of positive academic identities (Lampert, 2001), particularly with a group of boys who could be disruptive during classroom lessons. Revealing traces of the ethic of care and the importance of honoring human relatedness, critical theorist Jeff Duncan-Andrade's

(2009) argues that teachers should seek to “channel [rather than] manage” (p. 9) students’ negative emotions and actions. Namely:

> We may think that if we send out the ‘disobedient’ child, we have removed the pain from our system. It simply does not work that way [and] this ignores the fact that every student in our classroom is part of a delicate balance of interdependency…the decision to remove a child, rather than to heal her, is not only bad for the child but is also destructive to the social ecosystem of the classroom. (p. 9)

To maintain the “delicate balance of interdependency” within our classroom, I used confirmation to “pounce” on the productiveness of the group of boys. For example, the student exploration phase of the lesson was a potentially risky space for students to disengage, therefore, I would immediately highlight students’ initial productiveness as a way to extend their academic engagement:

> Early on, I pounced on Isaiah and complimented him when he was working at his seat and volunteering a comment or two. I told him I really appreciated how he was sharing his ideas and thinking with us because he had so many great ideas and it was helpful for the kids to learn from him. From there, he consistently participated…and was the first one to be ready. (Reflective Journal, January 7, 2013)

In addition to confirming students within the classroom, I also made phone calls, sent emails, or wrote notes home to students’ parents and guardians as an additional way of recognizing students. These interactions allowed me to connect with students’ families, deepen my understanding of students’ lives, and weave this knowledge into my classroom interactions with students as a way of developing our relationship and supporting their mathematical engagement.

Selective seating. Seating some students in particular places within the classroom was another strategy I used to create micro-opportunities for students to engage in learning activities. Again, I leveraged my knowledge of individual students to create classroom spaces that would enhance their opportunities to learn and participate in classroom activities. For example, after noticing the limited discursive participation of Angela, a quiet English language learner, during our whole-class discussions, I chose to move her from the back to the front of the classroom which appeared to benefit her participation:

> More participation from Angela today! Three days in a row now. Moving her up closer to the front from the back seems to really benefit her. (Reflective Journal, February 4, 2013)

Other times, I leveraged my knowledge of students' personalities to consider who they might productively collaborate with when solving a mathematical task. For example, Jason was a particularly sensitive boy, and it could be challenging for him to work collaboratively with others. To support his classroom engagement, I chose to move him next to Melissa, one of the more interpersonally skilled students in our class:

> I think that sitting next to Melissa has been a great resource for [Jason] – she's patient and seems to recognize that Jason's a kid who is sensitive and gets frustrated easily, and I see them working together as partners well. He generally has issues with whomever he sits next to, and some of the kids like to pick on him which leads him to shut down. But, so far so good with Melissa. (Reflective Journal, January 15, 2013)

Taken together, these instructional practices where aimed to create opportunities and conditions to enable individual students to productively engage in the classroom and enhance their mathematical participation.

Summary

The primary purpose of this chapter was to illustrate the ways in which the abstract notion of care manifested itself in my mathematics instruction through the pedagogical approach of an integrated caring approach (ICA). From a theoretical perspective, I wanted to better understand how ICA and the three dimensions of care influenced my mathematics teaching and my interactions with students. I also examined how this approach influenced the ways in which I strived to create and enable students to take up opportunities to learn to support their mathematics participation in the classroom.

Drawing from my teacher-reflective journal data and classroom lessons, and relying on other sources when relevant, the analysis of my data indicates that the three dimensions of personal, mathematical, and political care guided my structure of the learning environment and my dynamic interactions with the fourth-grade students. In particular, analysis illuminates the presence of four caring practices in my mathematics instruction across the intervention. Specifically, my enactments of care revolved around making content accessible to students, explicitly disrupting students' traditional perceptions of the discipline and mathematical competence, establishing a collaborative classroom context, and remaining sensitive to the needs of individual students as well as the collective class. These patterned ways of interacting with the fourth-grade students across the intervention were motivated by my interpretation of the overall classroom climate, my desire to be responsive to students' perceived needs, and to form productive working relationships with them.

In this chapter and the previous one, I presented the broader classroom context, student-teacher interactions, and classroom practices evolving from an integrated caring approach to practice. Taken together, the caring practices and instructional strategies represent the overarching ways I enacted care for the fourth-grade students across the intervention. With this as a backdrop, I now turn to the question of how students responded to an integrated caring approach to practice and to my enactments of care. In the next chapter, I explore students' mathematical experiences and how an integrated caring approach influenced their mathematics learning, with particular respect to their classroom participation and emerging dispositions.

CHAPTER 7: EXAMINING STUDENTS' MATHEMATICAL DISPOSITIONS AND CLASSROOM EXPERIENCES

Overview

Thus far in this dissertation, I have examined the process of building pedagogical relationships from the perspective of a teacher and a researcher. In Chapter 5, I described the initial work of establishing student-teacher relationships in the fourth grade classroom from my insider point of view of the one-caring teacher (Noddings, 1984), focusing on the ways I strived to get to know students as individuals and mathematics learners during the early days of the intervention. In Chapter 6, I analyzed my mathematics instruction from a more distanced perspective and identified four caring practices and related instructional strategies that evolved from an integrated caring approach (ICA) to mathematics practice.

In this chapter, I turn to the mathematical experiences of the students in the fourth-grade class and examine an integrated caring approach from the students' perspectives. Recall that on a theoretical level, *caring* is a relational process that develops between the one-caring teacher and the cared-for student. The key idea here is that caring is not dependent on what the teacher does for the student, but rather on how students interpret and experience the teacher's enactments of care. As Tarlow (1996) explains:

> The efforts of the caring person must be perceived and interpreted as valued by the person cared for. Caring must be understood as ongoing and mutual, a process requiring effort on the part of both persons. (p. 80)

In what follows, I forefront the experiences of the students in the fourth-grade class and focus on how students responded to my enactments of care, or the caring practices that emerged from an integrated caring approach to mathematics instruction. I privilege students' voices in this chapter because students "should be taken seriously and attended to as knowledgeable participants" (Cook-Sather, 2002, p. 3) in the learning process.

The discussion below is also motivated by Gresalfi and Cobb's (2006) call for the importance of focusing on the subject-specific dispositions students develop in the classroom. Specifically:

> conceptions of content should be broadened beyond the ideas, skills, and proficiencies of particular subject matter disciplines in order to consider the kinds of dispositions that students are developing towards those disciplines. (p. 49)

Therefore, a complementary aim of this chapter is to examine students' mathematical experiences during the intervention for the purposes of making connections between classroom practices and students' emerging dispositions towards mathematics.

For my purposes here, I rely on Gresalfi and Cobb's (2006) conception of *disposition* and define it as the "ideas about, values of, and ways of participating with a discipline that students develop in a particular class" (p. 50). I specifically focus on the emergence of two aspects of student mathematical dispositions: views of mathematical competence and willingness to share mathematical strategies during whole-class discussions. I also examine students' mathematical experiences, focusing specifically on their affective responses (e.g., their likes and dislikes) to understand how students were making meaning of our classroom practices and to illuminate the particular factors that influenced whether and how students took up mathematical opportunities to learn.

As a final note, I draw on Jansen's (2006) definition of a mathematical discussion of "talking about mathematics in a whole-class setting [which] is in contrast to more specific forms of mathematics classroom discussion, including more inquiry-based forms of talk (Goos, 2004)" (p. 412) to define the discussions that took place in our classroom. I make this distinction to be clear that, although I aimed to support students in using the mathematical practices of argumentation and justification, I do not claim our discussions always met these ambitious goals. My use of the term "discussion" characterizes what mathematical discussion looked like in our classroom. Our mathematical discussions centered on making one's thinking public, which is why I refer to this broader conceptualization of discussion here.

The analysis in this chapter is guided by the following research questions:

- How do fourth grade students respond to an integrated caring approach to mathematics practice?
    - In what ways do fourth grade students' mathematical dispositions shift with their engagement in classroom mathematical practices?
    - What factors do students report as influencing their mathematical experiences in the fourth-grade classroom, with particular attention to their affective responses to classroom mathematics practices?

Relevant Literature

Over the years, researchers have made important links between students' mathematical dispositions and their engagement and participation in classrooms (e.g., Boaler & Greeno, 2002; Gresalfi, 2009). The recognition of a *productive mathematical disposition* as one of the five interwoven strands in the National Research Council's conception of a mathematical proficient[11] student (NRC, 2001) further instantiates the field's awareness that the orientations and dispositions students develop towards mathematics matter. Research also indicates that classroom mathematical practices shape

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[11] The five strands of mathematical proficiency include conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (NRC, 2001).

the perceptions one has of their own mathematical competencies (Jansen, 2012), the extent to which one identifies with the discipline (Anderson, 2000; Horn, 2008) and how one comes to conceptualize what it means to be a doer and learner of mathematics (Anderson, 2000). What remains unclear from this body of work, however, are *how* and *why* classroom practices influence student mathematical dispositions in the ways that they do (Gresalfi, 2009).

To this end, another line of inquiry reveals that attending to classroom practices from students' perspectives provides valuable insight that can lead to more equitable classroom outcomes (e.g., Civil & Planas, 2004; Cook-Sather, 2002; Jansen, 2012). For example, Civil and Planas's (2004) work with elementary school students revealed students were cognizant of the social and organizational "barriers" (p. 8) that inhibited their mathematics participation in the classroom. Jansen's (2012) study with middle-school mathematics students similarly demonstrates that examining classroom contexts from the student perspective contributes important insights into the ways small-group work can be restructured to enable stronger mathematical outcomes. Specifically, "because of who they are, what they know, and how they are positioned, students must be recognized as having knowledge essential to the development of sound educational policies and practices" (Cook-Sather, 2002, p. 12).

Taken together, gaining access to students' mathematical experiences is essential to improve instructional practices and make learning more accessible for all students. Additionally and, of particular relevance to this study, understanding how students interpret the mathematical activities with which they are engaging in the classroom can provide insight into how teachers can form productive working relationships with their students while aiming for ambitious mathematical outcomes.

Data and Methods of Analysis

Data Sources

Two principal concerns drove my data analysis: examining students' emerging mathematical dispositions and understanding their mathematical experiences in the classroom. Therefore, the primary sources of data I drew on for the analysis in this chapter were student pre- and post-surveys, and student interviews conducted at the beginning and end of the intervention[12]. The survey analysis allowed me to capture student patterns in broad strokes across the fourth grade class while individual student interviews allowed me to probe more deeply into students' survey responses. My teacher reflective journal was used illustratively to support whole-class trends that emerged from my analysis of student surveys and interviews.

I analyzed four questions from the student survey to conceptualize students' emerging mathematical dispositions and mathematical experiences. I display the question prompts, the type of student response, information about the time of administration, and the particular focus of analysis for each question in Table 2.

Questions 1 and 2 of the survey were designed to tap into two aspects of students' mathematical dispositions: their views of mathematical competence and their willingness to participate in mathematical discussions, respectively. Student responses to the open-ended prompt in Question 1 helped me identify students' conceptions of what it meant to be "good" at math, and Question 2, a multiple choice question, gathered information

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[12] See Chapter 4 for a detailed explanation of survey and interview methods.

about student willingness to participate in mathematical discussions. In this question, students chose from among 4 available choices: *never, a little bit, some of the time,* and *most of the time*. A comparison of student responses to these two questions at the beginning and end of the intervention helped me identify shifts in students' mathematical dispositions, specifically in their views of mathematical competence and willingness to share their mathematical strategies during whole-class discussions.

Table 2. Student survey questions used in analysis

	Statement of prompt	**Type of response**	**Time of administration**	**Analyzed for**
Question 1	What does it mean to be good at math?	Open-ended	Beginning/end of intervention	Emerging mathematical dispositions
Question 2	I like to share my math strategies in class.	Multiple Choice	Beginning/end of intervention	Emerging mathematical dispositions
Question 3	What do you like about learning math through discussions?	Open-ended	End of intervention	Mathematical experiences
Question 4	What do you dislike about learning math through discussions?	Open-ended	End of intervention	Mathematical experiences

Questions 3 and 4 centered on constructing students' mathematical experiences with an integrated caring approach, or what I referred to students as "learning mathematics through discussions". These two open-ended questions were administered once at the end of the intervention. The questions aimed to examine students' affective responses (e.g., their likes and dislikes) to classroom practices and understand reasons that influenced whether and how students participated in and took up (or not) opportunities to learn in the classroom.

Transcripts of my interviews with students at the beginning and end of the intervention allowed me to probe more deeply into students' survey responses and provided insight into the ways students were interpreting and valuing (or not) classroom practices. In these semi-structured interviews (see Appendix D for interview protocol), I was interested in understanding how students were making sense of classroom practices, whether and how they identified with these practices, and what factors led them to take up (or not) opportunities to learn. The second interview, in particular, allowed me to better understand any changes in students' survey responses at the end of the intervention and identify classroom factors that appeared to shape students' mathematical dispositions or classroom experiences.

Analytic Method

An open-coding technique (Strauss & Corbin, 1990) of highlighting, labeling, and categorizing was used as the overarching method of analysis. To conceptualize students' mathematical dispositions, I began identifying general themes in students' responses to their views on mathematical competence by engaging in iterative cycles of open coding. I began the coding process by listing all 28 student responses to Question 1 on one document and reading through all responses (Coffey & Atkinson, 1996). For my initial pass, I engaged in pre-coding (Saldaña, 2009) and flagged, highlighted, or underlined words or phrases I believed would be important to attend to during the coding process. For my second pass, I created in-vivo codes (Corbin & Strauss, 2008) from student responses (e.g., "good at math", "pay attention to teacher"), and for my third pass, I began clustering similar codes into categories. For example, I clustered the three initial codes of "listening", "paying attention" and "show your work" under the broader category of *exhibiting classroom behaviors*. In addition, a single student response often had two or more statements that spoke to different dimensions of mathematical competence. Therefore, multiple codes could be used for a single response. As an example, Figure 3 provides a sample student response to Question 1 and an illustration of coding.

Figure 3. Sample coded student response

To be good at math means to learn from one another (*Collaboration*). It also means to try different math strategies and trying new ideas when the first idea doesn't make sence [*sic*]. (*Problem-solving and understanding*).

I followed the same coding process to code Questions 3 and 4 to conceptualize students' mathematical experiences in the classroom. For Question 2, I recorded frequencies of student responses to the four possible choices available. Transcripts of student interview data were reviewed to affirm and elaborate the themes that emerged from students' survey responses to the four questions. Relevant literature was referenced throughout the process to understand, label, and inform analysis of students' survey responses. After coding all survey responses and interviews, I compiled these identified patterns and themes, which are discussed in the next section.

Findings

I present my findings in three parts below. I begin by addressing the issue of students' initial mathematical dispositions, focusing on their views of mathematical competence and willingness to participate in our classroom discussions at the beginning of the intervention. Second, I compare students' emerging mathematical dispositions at the end of the intervention after their engagement with classroom practices. In the third section, I present the mathematical experiences of these fourth-grade students, detailing their reported affective responses to aspects of classroom practices and the reasons they provide to explain their mathematical participation.

Initial Mathematical Dispositions

Views of mathematical competence. The initial perspectives of the fourth grade students indicated that many of them held traditional and narrow conceptions of mathematical competence, converging on findings that have commonly been reported in the field (e.g., Garofalo, 1989; Kloosterman, 2002; Spangler, 1992) According to students, competent mathematics learners achieved high scores, did a "great" job, followed specific behaviors or were adept with numbers and arithmetic. To a lesser degree, students' conceptions of mathematical competence aligned with characteristics of a productive mathematical disposition (NRC, 2001), specifically the notions of effort and persistence and problem-solving. In general, however, students "did not seem to be aware of their own mathematical competencies, strategies and problem-solving abilities in mathematics" (Young-Loveridge, Taylor, Sharma, & Hawera, 2006, p. 584).

High Performance. Half of the responses of the fourth grade students (14 out of 28) revealed a performance-based view (Young-Loveridge et al., 2006) of learning mathematics that was linked to achieving high scores, not making mistakes, or learning mathematics easily and quickly. Students expressed that good learners are those who do well on their tests and assignments, and do not make mistakes. For example, Sean wrote that, "Being good at math means having a great grade" and Jason wrote that it meant, "to not get 50%. To get 100%". Anisa suggested it was okay to make some mistakes, but that someone who was good at math would "know most of the answers".

Table 3. Student views of mathematical competence

Initial Views	Students	Emerging Views	Students
High performance	14	Effort and persistence	8
Exhibiting classroom behaviors	9	Problem-solving & understanding	7
Generic ideas	8	Collaboration*	7
Effort and persistence	5	High performance	6
Numbers and operations	4	Exhibiting classroom behaviors	5
Problem-solving & understanding	4	Numbers and operations	3
		Mathematician*	3
		Smartness*	2
		Generic ideas	2
		Resources*	2
		Nervousness*	1

*Emergence of new theme

Like his classmates, Rohan believed good math learners generally made few mistakes, and he identified this as one of the reasons for his competence in mathematics:

> NT: Can you give me some reasons why you think you're good at math?
>
> R: Because, because, like my mom always checks it and sometimes I only get a little wrong. Sometimes I get a lot right, [but] then most of the time, I always get them right. (Interview 1, January 8, 2013).

Rohan conceptualized himself as a good learner because he performed well (i.e., "most of the time, I always get them right") and made few errors ((i.e., "sometimes I only get a little wrong"). It seems important to note that, in this comment, Rohan also positioned himself in a passive learning role compared to a more mathematically knowledgeable other (i.e., "my mom always checks it").

Students also described a mathematically strong student as someone who learned mathematics easily and experienced little struggle. According to Alex and Tui, good learners "don't have trouble" and "can answer the problem easy", respectively. In addition to achieving high scores, Carol linked mathematical competence with the notion of speed. As she wrote, "[good learners] know most or all the anser [*sic*]. And to know the anser [*sic*] right away [is] to be excelent [*sic*] at math".

Exhibiting classroom behaviors. According to nine students, those who are good at mathematics display particular behaviors as they are learning in the classroom. Students identified specific actions that good learners demonstrate, namely they "pay attention", "listen", or "show [their] work". Students also indicated that good mathematics learners could be identified not only by visible actions, but also by their non-actions. That is, mathematically capable students solved problems on their own and did not seek input from others. For example, Cindy explained that, "[being good at math] is like when you do it and you don't asked [*sic*] for help". Her response intimates that those who ask for help are less capable than those who work on their own, while simultaneously portraying the process of learning mathematics as a solitary activity that one engages in individually.

In many of these responses (5 out of 9), students positioned themselves in a subordinate role to the mathematics teacher. Students shared that students who were good at math would listen or pay attention to the teacher. Melissa indicated that she did not think students could be competent math learners unless they listened to the teacher:

> NT: What makes some people good at math and others not good?
>
> M: By paying attention to the teacher.
>
> NT: How does paying attention to the teacher make someone good at math?
>
> M: Because the teacher shows you what to do. Like, you can listen and follow what the teacher's doing by looking at the board and watching what she's doing.
>
> NT: Mm-hmm. Is that how you like to learn math?
>
> M: Yes. (Interview 1, January 8, 2013)

Aligning with Rohan's response earlier, Melissa also positioned herself in a passive learning role as she described the ways she received knowledge from the teacher (i.e., you "listen", "follow", and "watch" what the teacher is "doing"). Her response also indicates a personal preference for learning mathematics when the teacher "shows you what to do".

Leena also positioned the teacher as the mathematical authority in the classroom, and she did not appear to recognize that she could be a source of mathematical knowledge for herself. During our interview, I asked her to consider how she would learn if the teacher was not available:

> NT: How do you think someone might learn math if there was no teacher to pay attention to?
>
> L: Um.
>
> NT: So I wonder…what if someone gave you a problem to work on but didn't show you how to do it?
>
> L: Then I wouldn't be able to solve it or anything. At home, I'll just, like, ask my brother or sister to help me on it. But if I was at school and like my brother or sister is not there, then I'll just try my hardest just to get it. But if, like, you're not paying attention or, like, you're not learning, then I'm not going to get the answer right or anything. (Interview 1, January 8, 2013)

Generic ideas. In contrast to the specific indicators described above, eight students used generic and non-specific terms to describe the qualities of a mathematically competent student. For example, students suggested that being good at math meant "to know math", "to do great", or "to be good at it". These students did not expand on their responses or provide concrete examples of the kinds of things a good mathematics learner might do in the classroom.

Numbers and operations. Four students reported that good mathematics learners had strong knowledge of numbers and operations and arithmetic. Emanuel suggested that "counting really good [and] knowing how much money you have" indicated that someone was good at math. Edward, wrote that knowing how "to multiply, divide, add and subtract" demonstrated one's competence. Angela confirmed his statement by stating that strong mathematics learners "really know [their] math facts". Kamari also privileged the mathematical topic of arithmetic when describing a mathematically competent student. He expressed that:

> K: [Being good at math means] Like you know how to add, like, numbers together to make them bigger.
>
> NT: Um-hmm. So it sounds like you're saying someone who's good at math can add numbers together? Okay. What else do you think it takes to be good at math?
>
> K: And times. Like, when you don't know some numbers you can divide. And, um, you can, like, split them, separate them. Take away or regroup. Well, like, you get your addition, subtraction, multiplication and division down. That makes you good at math.
>
> NT: Okay. Anything else?
>
> K: Not really. (Interview 1, January 8, 2013)

Problem-solving, effort and persistence. To a lesser degree, students' identified two characteristics of mathematically competent students that aligned with the notion of a productive mathematical disposition (NRC, 2001). Five students recognized that good mathematics learners exercised effort and persistence in the face of challenge. In particular, good learners "always try [their] best" or "never stop". Libby responded that "[being good at math] means to try to do the one you don't get" suggested that good mathematics learners not only persevere in the face of challenging problems, they specifically seek them out. Four students linked mathematical competence with solving problems and understanding. Specifically, these students indicated that it was important "to understand math" or be "a good solver". These responses, however, remained at a general level, and students did not provide specific examples to support their responses.

Willingness to share mathematical strategies. Sharing one's mathematical ideas publicly is an important aspect of learning and doing mathematics in classrooms that aim to implement ambitious mathematical practices and attend to students' mathematical thinking (Hiebert & Grouws, 2007). However, as I shared earlier in Chapters 5 and 6, the fourth-grade students did not eagerly take up the opportunity to engage in mathematical discussions, particularly in the early stages of the intervention. Students' survey responses revealed that the majority of the class preferred not to share their mathematical ideas with the class. Specifically, 10 of the 28 students indicated they "never" liked to share their strategies, 11 students liked doing it "a little", four students "sometimes' liked sharing, and only three students indicated they were willing to share their strategies "most of the time" (See Figure 4).

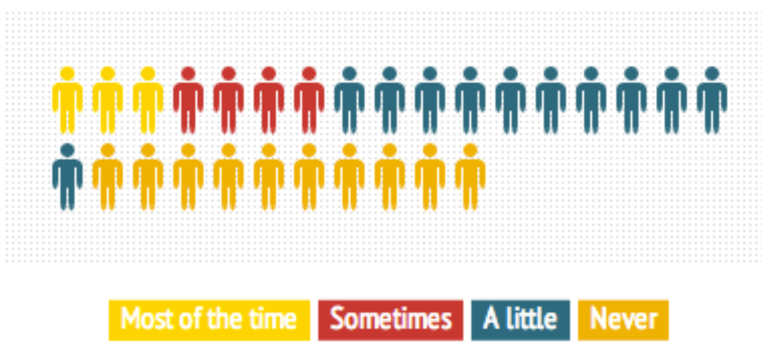


Figure 4. Students' initial willingness to participate in mathematical discussions

My interviews with individual students confirmed the patterns I found among students' survey responses, and students offered important reasons to explain their reluctance to participate in discussions. Specifically, their concerns revolved around three interrelated issues: sharing in front of a large group of people, making a mathematical mistake in front of the class, and the nature of their relationships with their classmates.

Jewel shared that the public aspect of sharing strategies in front of the whole class inhibited her desire to participate. She recognized that sharing her solution with the class would draw attention to her and this appeared to make her uncomfortable. She explained that "[sharing my strategy] makes me nervous because I know other people are watching me, so I don't like to do it" (Interview 1, January 9, 2013). For Sirenity her conception of herself as a "shy" person influenced her willingness to participate:

> NT: How do you feel about sharing your ideas out loud with the class?
>
> S: I really don't like it 'cause I'm shy a lot.
>
> NT: Um-hmm. You just made a face when you said that.
>
> S: Yeah. I really don't like it. I don't like talking in front of so many people. (Interview 1, January 8, 2013)

Like the two girls, Rohan was aware that being a strategy-sharer meant there would be an audience watching and listening. In addition, he recognized that making his mathematical ideas visible also meant that his ideas would be open for evaluation by others. He described his strategy-sharing experiences to me in this way: "It's like…I feel like I'm on a stage with, like, a lot of people watching me. And then if you're wrong, maybe people will laugh at you." (Interview 2, March 14, 2013). Therefore, Rohan recognized that sharing his mathematical ideas with the class meant that he was placing himself in a vulnerable and potentially risky position, particularly if his ideas were not considered thoughtfully or respectfully by his classmates.

The possibility of making a public mistake in front of the class also hindered Justin from participating. In particular, limiting his participation seemed to be a way to mitigate the potential risks of appearing less competent in front of his classmates and save face so to speak. Justin indicated he did not like sharing his strategies "that much" but suggested he would be more willing to participate "if I knew my answer was right" (Interview 1, January 9, 2013).

Other students reported that their willingness to participate was influenced by the nature of their relationships with their peers. These students expressed feeling apprehensive that their classmates would make fun of them for sharing their ideas, particularly if they made a mistake. Colin reported feeling:

> kind of afraid to [share my strategies out loud] because if I get it, like, wrong, I'm afraid the class would laugh at me. Because, uh, at school, a lot kids laugh at the other kids, and I'm just afraid they'll laugh at me for getting one of the answers wrong. Like once I said the wrong answer before and I got laughed at. (Interview 1, January 8, 2013)

When describing classroom conditions that would increase the likelihood of her participation, Sofiya indicated she would be willing if there were lowered risks:

> NT: Is there anything you can think of that might make you want to share your ideas with the whole class?
>
> S: Um, well, if I knew that people wouldn't make fun of me.
>
> NT: Is there anyone specific in our class that you're worried about?
>
> S: Yes.
>
> NT: Do you feel comfortable telling me who?
>
> S: Kyler.
>
> NT: Why Kyler?
>
> S: Because he's mean. He always makes fun of everybody. And then Stephen and other people laugh, too. He's been doing it since second grade. (Interview 1, January 9, 2013)

Interestingly, Kyler also cited concerns that others might tease him to explain his reluctance to share his strategies publicly. He shared that, “I don’t know, maybe some people might make fun of you or something. Then I probably wouldn’t want to do it.” (Interview 1, January 8, 2013)

Several students referenced the increased class size between third and fourth grades when explaining their reluctance to participate in classroom discussions. Specifically, the increase from 20 to 34 students not only meant there were more students in one classroom, but it also meant that students were less likely to know one another well. Colin noted, “I’d probably share more if there [were] less kids” (Interview 1, January 8, 2013). Jewel articulated, “there’s a lot more kids in our class now than last year” and also cited the fact that “I’m not really friends with everyone” (Interview 1, January 9, 2013) as a reason why she did not feel as comfortable sharing her ideas publicly. For Jewel, her perception that she did not know all the students in the class well enough to consider them her “friends” negatively shaped her participation. When I asked her how many students she would feel comfortable sharing her thinking with, she said “about half”. Leena similarly reported that she would be willing to share her ideas if there were “like 10 students” (Interview 1, January 8, 2013).

Emerging Mathematical Dispositions

Views of mathematical competence. An analysis of students’ views at the end of the intervention revealed a broader perception of what it meant to be a doer and learner of mathematics as evidenced through the emergence of several new themes (see Table 3). Importantly, students’ responses shifted to reflect dimensions in alignment with those of a productive disposition (NRC, 2001). As outlined in Table 3, in contrast to their collective views at the beginning of the intervention, students prioritized the importance of effort and persistence, problem-solving and understanding, and collaboration. My analysis also indicates, however, that many students (14 of 28) continued to indicate that specific behaviors, a performance-based view of the discipline, and numbers and operations were characteristics of mathematically competent students.

Effort and persistence. An increased number of students recognized the importance of effort and perseverance when learning mathematics. Eight students suggested that characteristics such as “trying hard” and “giving [math] your best try” were indicators of mathematical competence. Anthony pointed out that good learners “don’t get distriecked [*sic*]” and “never give up when [they‘re] doing math”. Alex reasoned that, “if you keep trying, then it is not so hard for you to learn math”. Libby’s response linked the notions of effort and reasoning together. In her words, “[being good at math means] trying new ideas when the first idea doesn’t make sence [*sic*]”. Therefore, in her view, a mathematically competent learner spent time and effort re-strategizing based upon one’s initial reasoning.

Problem-solving and understanding. Seven students reported that learning strategies, problem-solving, or sense-making were characteristics aligned with competent mathematics learners. Jordan mentioned that good mathematics learners “understand what [they’re] doing”, and Emanuel shared that:

> Something that makes you good at math is learning new strategies. Another thing is to be good at solving problems.

Rohan, in particular, appeared to develop an appreciation for mathematical mistakes through his experiences with the intervention. Specifically, he viewed them as a learning opportunity and a mechanism for increasing one’s mathematical competence. In his words, “the thing that makes you good at math is to make some mistakes because you learn from your mistakes”. He went on to add, “getting anserws [*sic*] right is good, but getting anserws [*sic*] right dosen’t [*sic*] mean you are good at math. Its [*sic*] about what you think”. Rohan’s answer reveals that reasoning and making sense of one’s own thinking rather than mathematical correctness were the hallmarks of being a good math learner.

Collaboration. Seven students’ responses revealed that their conceptions of the discipline had shifted from viewing the discipline as a solitary activity to a collaborative one. These students indicated that competent learners work with and learn from others. Specifically, good learners “talk to people” or “ask other people about their ideas”. Daniel articulated that good learners “share [their] strategies with others [because] you learn together”. For Sirenity, being good at math meant “you can get different answers from others and it’s okay”. Her response implies an awareness that students might have different ideas about how to approach a problem, and that it was “okay” for students to think differently. Emanuel indicated that part of being a good mathematics learner involved “listening to other students’ math strategies because it can help you”. Turning Emanuel’s response on its head, Kamari suggested that being a good math learner meant “help[ing] others fix their mistakes”.

In our second interview, Jewel confirmed these students’ responses and explained that listening to her classmates’ strategies allowed her to simultaneously help others and learn from them as well:

> J: I like listening to other kids’ ideas because I can learn about what they’re saying, and I can help them, too. Like, if I see what they did wrong. I could help them by explaining what I see.

NT: What do you mean by what they did wrong?

J: Well, if I don't agree with them, as they're working up there [on the board] I could see if I could help them.

She went on to explain how hearing other students' ideas afforded the opportunity to strengthen her own mathematical understandings:

J: And if someone has a different idea than you, then somebody else's idea can connect to yours.

NT: Oh, can you say more about that?

J: Ideas can connect even if you learn it a different way. Because you could be doing different things but you could get the same answer. That's how they connect.

NT: So, that's one of the reasons why you like hearing other kids' ideas?

J: Mm-hmm. (Interview 2, March 12, 2013)

Jewel's response reflects an understanding that students could approach a mathematics problem in multiple ways (i.e., "if someone has a different idea than you", "you could be doing different things but you could get the same answer") and that it was possible to make connections between the different approaches students used (i.e., "ideas can connect even if you learn it a different way").

Students also appeared to develop an expanded conception of mathematical competence as evidenced by the emergence of several new themes in their post-intervention responses. Three students positioned a "mathmatishun [*sic*]" or someone who could "solve problems like a mathmatition [*sic*]" as an indicator of someone who was good at math. Two students linked a sense of competence with the notion of smartness or, as Carol put it, "being good at math [means] to be smart at it and know everything". Likely thinking of the public risks of strategy-sharing, Kyler associated feelings of apprehension with competence and suggested that being good at math meant "you get nervus [*sic*] sometimes". Two students referenced resourcefulness as indicators of a competent learner. Specifically, Justin and Anthony expressed that "draw[ing] models to help you" and using "a math chart to help your thinking", respectively, reflected characteristics of mathematical competence.

Although students developed a more nuanced conception of what it meant to be good at mathematics, students' post-intervention responses indicated that half of them (14 out of 28) held on to views of mathematical competence related to high performance, exhibiting particular classroom behaviors, or being adept with numbers and operations. Two students also continued to use generic and non-specific terms to describe the qualities of a mathematically competent student.

Figure 5. Students' emerging willingness to participate in mathematical discussions

Willingness to participate in mathematical discussions. Students in the fourth-grade class also developed more positive orientations towards sharing their mathematical ideas with their classmates compared to the beginning of the intervention (See Figure 5). In particular, students' willingness to participate in mathematical discussions increased during the intervention. Of the 28 students, 11 suggested they liked sharing their mathematical strategies "most of the time", six students "sometimes' liked sharing their strategies, eight students indicated they only liked doing it “a little”, and three students revealed that they “never” liked to share their strategies.

My observations of students’ participation during the intervention confirmed their growing inclination to participate in mathematical. In early February, I wrote:

> I’m noticing more kids are beginning to want to share their ideas. I’ve been making efforts to position Jason and Leena more often, and I’m noticing more participation from each of them. Dude raises his hand to share his strategies, too. It seems like some of the kids are beginning to enjoy our math discussions more, too. On his way out to lunch just now, David said to me, “I get more ideas when I talk about math and it gets my brain excited”. (Reflective Journal, February 4, 2013).

During our interviews, students cited several reasons for their increased willingness to participate in mathematical discussions. Students named their developing relationships with their peers, overcoming shyness, personal motivations to become more mathematically competent, or desires to help other students as influential factors. Jewel, for example, moved from liking to share “sometimes” to “most of the time”. When I asked her what accounted for this shift, she explained that her increased familiarity with the class, or more specifically, getting “used to” the other students supported her inclination to participate. She explained:

> J: Because everyday I’ve been in the classroom longer and, like, I know them better. Some of the kids I didn’t know before, ‘cause they were in a different class last year or they were new to [this school], and I’m used to them now.
>
> NT: So it sounds like you’re saying that spending time together and being more familiar with the kids in our class has made a difference?
>
> J: Yeah.
>
> NT: How does that, how does knowing the kids better make you more open to sharing your ideas with the whole class?
>
> J: Because…I’m not very sure. Just kind of feeling better being up in front of the class. (Interview 2, March 12, 2013)

Although Jewel did not explicitly articulate what made her feel "better" about sharing her mathematical strategies in front of the class, one possible interpretation is that her increased comfort and familiarity with her classmates decreased her aversion to speaking publicly and supported her in overcoming the perceived risks of participation. In other words, spending time with and ultimately developing relationships with the other students enhanced Jewel's willingness to engage. Viewed from the theoretical lens of care, the caring constructs of *time* and *being there* (Tarlow, 1996) appeared to create a space within the classroom that supported her in taking up classroom opportunities to participate.

Melissa also reported an increased willingness to contribute to classroom discussions, moving from liking to share her strategies "a little bit" to "most of the time". When asked to explain why she was more willing to participate, she explained that recurrent experiences of sharing her strategies in front of the class helped her overcome her self-identified shyness:

> NT: Why do you like sharing your strategies more now than you did in December?
>
> M: I like to show my ideas to people.
>
> NT: Uh-huh. And what makes you more willing to show your ideas now?
>
> M: In December I was shy, but now I'm not as much.
>
> NT: What do you think has made you feel less shy?
>
> M: I think to share what I've been doing…doing it more makes me feel less shy. I don't feel so afraid anymore when I go up there.
>
> NT: So it sounds like what you're saying is that going up and sharing your ideas more – doing it more – helped you feel less shy or afraid?

M: Mm-hmm.

NT: Would you say it got easier to do it over time?

M: Yes. (Interview 2, March 13, 2013)

For Melissa, it appears that repeatedly "performing" as a strategy-sharer increased her mathematical confidence and, by extension, increased her willingness to participate. Taking up the role of a strategy-sharer, in particular, appeared to serve as an instructional mechanism that contributed to the way Melissa began to see herself as a mathematics learner, that is seeing herself as a student who could participate in more central ways in the classroom over time (Jackson & Cobb, 2010).

Students also shared particular strategies they developed that supported them in overcoming their fears of sharing in front of the whole class. Colin, who moved from liking to share his strategies "a little bit" to "most of the time" noted that a useful strategy for him was to rehearse what he would say in front of the class before going up to the board. He described that, "If I practice what I'm going to say first, like it got easier to say in front of everyone because I knew what I was going to say" (Interview 2, March 13, 2013). Melissa explained that pretending other people were not around was useful for her, and her openness in sharing her perspective helped me make sense of some of her actions I had observed in the classroom.

> NT: What made you sort of push yourself and continue to do something that you really didn't like at first?
>
> M: To try it out and see what it's like 'cause I know it'll make me better at math. Um, like sometimes I would just go up there and show my idea but not really look at all the people. [That helped] to not make me scared or shy.
>
> NT: Ah, so when you would go up there you wouldn't look at the other kids?
>
> M: I just look at my work [on my paper].

NT: You just, oh, you look down at your paper when you go up there. Um, so is that sometimes why you would talk into your paper? Now I get it. So, it's almost like you forgot everybody was there because you couldn't see them. I understand why you would do that. (Interview 2, March 13, 2013)

Dude shifted from liking to share "a little bit" to "some of the time". This appeared to be shaped by two reasons; first, his perception that he got more answers "correct" through working on tasks, and second, his desire to learn more mathematics. He expressed that he was willing to share his ideas more because "most of the times, like before we started doing those problems, I used to get the answers wrong" (Interview 2, March 14, 2013). Dude's desire to learn more mathematics also appeared to motivate his participation. Early on in the intervention, he expressed an immediate willingness to participate more often in classroom discussions after I suggested that sharing one's ideas was an aspect of what it meant to do and learn mathematics:

NT: So it sounds like you don't like to be so public with your ideas.

D: Yeah.

NT: What if I told you that part of learning math is making your thinking public?

D: Then I would do it.

NT: Why?

D: Because I want to be better at math. (Interview 1, January 9, 2013)

Other students were motivated to share their mathematical thinking out loud with others for altruistic reasons, namely, in order to help their classmates learn mathematics. For example, Rohan indicated that "if people don't understand things and if I do, I can share my idea to help other people understand" (Interview 2, March 14, 2013).

All students' views of participating in mathematical discussions, however, did not shift. Justin remained willing to share his strategies with the class only "a little bit". As he did during our first interview, Justin referenced the notion of mathematical correctness and responded that he "might get the answer wrong in front of everyone". Thus, because learning mathematics was about getting the answer right or wrong, sharing his strategies publicly remained a risky move for Justin. Specifically, the risks of making a mathematical mistake in front of his classmates continued to limit his inclination to participate publicly, and his perspective did not change during the course of the intervention.

Like Justin, Leena's willingness to participate in classroom discussions also did not shift, and she remained at liking to share her strategies only "a little bit". Early on in the intervention, Leena described herself as a "shy" student to explain her reluctance to participate in our classroom discussions. Unlike Melissa, however, she did not come to see herself as a "strategy-sharer" despite her recurrent opportunities to publicly share her strategies. As she explained, "I just don't really like to say what I think in front of everyone out loud" (Interview 2, March 12, 2013). When I asked her whether or not she became more comfortable sharing her ideas publicly over time, she explicated that getting "used to" to sharing her strategies was different from identifying with doing so:

> NT: Did you get more used to sharing strategies in front of the class over time?
>
> L: Maybe a little.
>
> NT: Did [sharing your strategies] more make you feel more comfortable doing it?
>
> L: No. I got used to it like after the first time. People have to get comfortable saying out loud what they think or what they don't get. But, like, I don't really get comfortable saying what I think out loud. It's just sort of embarrassing. (Interview 2, March 12, 2013)

Leena also clarified that her willingness to share her strategies with the class had nothing to do with making a public mistake in front of the class.

> N: Would you be more willing to share your strategy if you knew your answer was correct?
>
> L: No. It doesn't matter. I wouldn't care if I got my answer right or wrong. It's just math. (Interview 2, March 12, 2013)

For Leena, the repeated opportunities to contribute to our classroom discussions did not appear to benefit her in the same way as Melissa, and providing her with more opportunities to take on a central role as a mathematics learner did not lead to a more positive disposition towards mathematics. While Melissa expressed in her interview above that sharing her strategies during our class discussions would "make [her] better at math", Leena did not seem to value strategy-sharing in the same way. Instead, Leena appeared to participate in our mathematical discussions out of a sense of compliance rather than a sense of identification (Cobb et al., 2009). Leena's case seems to indicate that having more opportunities to take on a central role as a mathematics learner in the classroom does not guarantee that one will necessarily *identify* with doing so.

It also seems important to mention that two of the three students who remained at "never" liking to share their mathematical strategies were second language learners who, according to the school's CELDT scores, were in the early phases of their English language development. Precious, who spoke Hmong as her first language, was in the Early-Intermediate phase of her English language development. Gerardo's first language was Spanish, and he was identified as being in the Beginning stage of his English language development. I did not have the opportunity to interview either of these students, thus I do not know what may have accounted for their continued reluctance.

Yet, given the discussion-focused nature of our classroom practices, it opens up the possibility that particular aspects of these practices may have had differentially negative impacts on some students.

Table 4. Student mathematical experiences with caring practices

What do you *like* about learning math through discussions?	**What do you *dislike* about learning math through discussions?**
Helped me learn more	Public aspects of strategy sharing
Collaborating with other students	Arguing with others
Having ownership of mathematical ideas	Difficulty understanding or explaining
Working on tasks	Tedious
Fun	Students who talk too much

Students' Mathematical Experiences

In the following section, I describe students' affective responses to the classroom practices that evolved from the pedagogical approach of ICA (See Table 4). Specifically, I classified mathematical experiences in the classroom according to the aspects of mathematics activities students reported liking or disliking.

Positive experiences with relational practices. Of the 28 students, 11 students indicated they valued classroom practices because it *helped them learn* or strengthened their understandings. Students did not always specify what they meant by this, and some responses remained at a general level (e.g., "I like it because you can learn from it"). However, some students did provide examples in their responses that provided insight. For example, Jordan indicated that he felt our classroom practices supported him in learning new ideas and articulating his mathematical thinking:

> I like to learn the stuff that I don't know how to do. And I didn't know a lot about how to talk about math. I like to learn more than I know now.

Justin suggested that “it helps you understand math better”, and Sofiya said that she “like[d] it because math is connecting to your own brain”. Dude indicated that the mathematical skills and practices we worked on in the classroom would be useful for him in the future. He reported, “[learning math through discussions] helps you for when you grow up [and] you get smarter and explain”.

Students also indicated they appreciated the *collaborative opportunities* to learn mathematics these practices afforded them. To use Lampert’s (2001) terms, students came to see one another as “academic resources for themselves and for one another” (p. 266). Specifically, 12 students liked working on problems with their classmates or hearing about other students’ strategies. Angela wrote that she “like[d] learning from a lot of people”, and Edward indicated he liked “to talk about it with other people and agree and disagree”.

Other students specifically noted that listening to other students’ strategies and hearing multiple ways of thinking mathematically supported their understandings. For example, Lacie found the opportunity to “learn from a different perspecktiv [*sic*] or different person” useful. Leena wrote that hearing other students’ strategies “help[ed] give [her] ideas of how to start or solve the problem”, and Cindy found that working with other students was helpful “because if I have mistaks [*sic*], my colleagues help me”.

Having the opportunity to share their mathematical ideas with classmates gave some students a sense of *ownership over their mathematical ideas*. For example, Tui wrote:

> What I like about [learning math through discussions] is that I can share my ideas, answers, and explanations because everybody will know what I’m saying. I like to share my ideas because it will make my brain think of more ideas. Sharing is very

> good for your brain because it will make your brain bring up more ideas to tell [your] colleeges [*sic*].

Tui recognized that sharing his strategies with the class positioned him as a mathematically competent student, which he seemed to appreciate (i.e., "everybody will know what I'm saying"). His response also indicates that talking about his thinking and discussing his ideas with his classmates enabled him to come up with additional ideas (i.e., "it will make my brain think of more ideas") and supported his intellectual autonomy.

Libby and Kyler each mentioned that *working on mathematical tasks* was the aspect of classroom activities they liked the best. Both students specified the particular tasks that were memorable for them. For example, Libby noted that "[the problems] were fun. But the problem where the kids shared the brownies was my favorite". Kyler said that "I like doing those problems. I liked when my name was in it. But [those problems] are hard". Kyler's response indicates he had developed an appreciation for open-ended tasks, even though he found them challenging.

Working on tasks also resonated with Dude, and he referenced them early on in the intervention when explaining why he thought he was good at math:

> NT: Can you explain what makes you a good math learner?
>
> D: Because I'm learning a lot from the math questions you always give us.
>
> NT: Which math questions?
>
> D: You know, how, um, the problems with our names in them.
>
> NT: Oh, the math tasks?
>
> D: Yeah.
>
> NT: Why do you like those problems?

D: Because they're harder for me.

NT: What makes them harder for you?

D: Because, like, you've got to do it a lot of different ways. So then, you've got to figure out if one way works or not. That's sort of what makes it hard for me.

NT: Mm-hmm.

D: I don't really know that many different ways of doing math. So, um, that's what I like about it. (Interview 1, January 9, 2013)

Finally, the responses of three students reported they found the classroom activities *fun*, as evidenced by their use of the words "fun" and "cool" to describe what they liked about classroom practices.

Negative experiences with relational practices. Students raised a variety of ideas in response to aspects of classroom mathematics activities they disliked (see Table 4), several of which centered around issues related to public and social aspects of learning mathematics. Perhaps unsurprisingly, students' responses converged upon the earlier findings related to student willingness to *publicly participate in classroom discussions*; specifically, sharing strategies publicly and the risk of making mistakes in front of their classmates. Students also reported four other aspects of classroom activities they disliked: *engaging in mathematical arguments* with their friends, *difficulties understanding or explaining ideas*, finding *classroom activities tedious*, and *students who talked too much*.

Seven students indicated that sharing solution strategies with the class was the aspect of our classroom activities they disliked the most. Students again reported being concerned with sharing their thinking out loud publicly with others. As Precious illustrated in her response: "I didn't like sharing my things out loud when people are listning [*sic*]". For others, the physical act of standing in front of the class appeared to be the most stressful aspect of sharing their strategy. For example, Sirenity said she "[didn't] like going up there to show my answer", and Jewel noted that she "dislik[ed] standing in front of the class". Therefore, while Precious's aversion to sharing her ideas appeared to focus on the risks of opening up her mathematical thinking to a wider audience, it is possible that Sirenity and Jewel did not necessarily mind putting their mathematical ideas up for discussion, but rather they disliked standing up in front of the class when doing so. Jewel confirmed this interpretation by expressing, "I'm okay with sharing my ideas if I can do it from my seat" (Interview 1, January 9, 2013).

Making mistakes is a central and unavoidable aspect of learning mathematics and "defines the very nature of learning, for if we already knew everything we would never have to do such things" (Lampert, 2001, p. 266). Yet, making mistakes in a public space presents both social and emotional risk, particularly if one believes making mistakes is an indicator of one's (in)competence rather than an acceptable and productive part of learning (Borasi, 1996).

Students in our classroom were expected to share their ideas even if they were uncertain or incorrect, and five students cited the potential of making mistakes as the aspect of mathematical activities they disliked. Justin said he disliked our classroom activities because "you might get the wrong answer in front of your colleagues", and Cindy said that "it is embearassing [*sic*] to make mistakes in front of other people". Sofiya added that "I dislike it when my colleaguez [*sic*] yell out that I have a wrong answer. It makes me feel bad". Although I strived to reframe mistakes as meaningful learning opportunities and create conditions that supported students in taking intellectual risks, all students did not find the classroom a safe space to share their mathematical ideas.

A new theme that arose in relation to participating in classroom discussions was students' discomfort with the process of *engaging in mathematical arguments* with their classmates. Specifically, four students expressed they disliked the process of agreeing and disagreeing with one another's mathematical approaches and solutions. Speaking broadly, Carol noted she did not like "when we say 'I agree' or 'I disagree'". For Jordan and Rohan, however, engaging in mathematical arguments during our lessons caused conflict in their friendship.

To provide context, Jordan and Rohan were best friends who frequently spent time together both inside and outside the classroom. The two boys sat next to one another in the classroom and often collaborated when solving tasks and presenting their strategies to the class. From my observations, they seemed to work together quite functionally, and I noted in my reflective journal:

> Rohan and Jordan did a nice job of sharing their idea with the class. It was great to see how they modeled working together for the class – I noticed them discussing who should draw as they were walking up to the board, and Rohan began by drawing and explaining. Then when I asked another question, they conferred with one another and decided that Jordan would talk. (January 23, 2013)

Yet, in their written responses, both students separately revealed bubbling tensions in their working relationship. Rohan expressed that, "I don't like it when we disagree with one another and also when we get into arguments on what's the right answer", and Jordan specifically pointed out that he "[didn't] like it when we disagree with our friends". Recall also that I shared in Chapter 6 that Rohan indicated in his "Hello, World" writing activity that he wanted to live in a world “where no one will fight and everyone will be nice”.

During our interview, Rohan disclosed that he and Jordan ran into difficulties understanding one another’s point of view when discussing their mathematical approaches to a problem. Specifically, they would get into “real” arguments if they did not come to a consensus on how to approach the problem. Rohan detailed:

> R: Like sometimes I didn’t agree with [Jordan’s] idea and then we would get into an argument on which one was right. And then sometimes I just agreed with him.
>
> NT: What do you mean that sometimes you “just agreed with him”?
>
> R: Sometimes I did agree with him, and sometimes I just did it because I wanted to make him feel better instead of, like, getting angry and all of that. Because like…it was, like, real arguing. I tried to convince him that, like, the answer I had was correct.
>
> NT: And what happened when you tried to convince him?
>
> R: He gets angry and he starts, like, getting mad, and then I feel sorry for him because he is, like, using all of his energy to, like, convince me.
>
> NT: So it sounds like [Jordan] gets really…oh, what we might call “animated” or “passionate”. Does he start moving around a lot or using his hands because he is really excited and trying hard to convince you?
>
> R: Uh-huh. But he gets, like, really angry, and it makes me feel, like, sort of sad. (Interview 2, March 14, 2013)

Although I attempted to reframe Rohan’s perception of Jordan’s “anger”, Rohan remained unconvinced (i.e., “but he is getting like really angry”), and these interactions with his friend affected him (i.e., “it makes me feel…sort of, sad”). As our interview continued, Rohan reported these tensions with Jordan would, at times, carry over into lunch recess and the two of them would not play together as they usually did on those days.

The experiences of these fourth-grade students map onto the experiences of the fifth-grade students in Lampert, Rittenhouse, and Crumbaugh's (1996) study. These students also struggled with learning how to disagree politely, taking on the risk of being wrong in public, and fighting off the sense that being on the receiving end of a mathematical disagreement was a personal attack, or in the words of one student Saundra, "[it] makes you sort of feel like you want to crawl into a hole and die" (p. 742).

Lampert and colleagues insightfully point out that classroom practices such as engaging in mathematical arguments "are not the activities that most people think of when trying to learn something new" (p. 740). They specify that cultural differences between academic and school institutions complicate the ways in which visions of practice make their way into elementary classrooms:

> In the academic world, arguing about ideas is supposed to be our stock-in trade although in fact we rarely engage in doing it face to face…[but] in the world of schoolchildren, arguing and disagreeing are closer to agitation and quarreling – not something you would do to a friend…children do not readily separate the quality of the ideas from the person expressing those ideas in judging the veracity of assertions. (p. 740)

In the vision of ambitious mathematics instruction, engaging students in the mathematical practices of reasoning, justification, and argumentation is intended, among other things, to promote the learning of mathematics as a process of sense-making. Yet, the ways students experience and interpret these forms of mathematical discourse clearly differ from the instructional intentions of visionaries, as evidenced by the mathematical experiences of Lampert et al.'s fifth-grade students and these fourth-grade students.

Rohan and Jordan's interactions reveal that "arguing" about mathematical ideas with peers can potentially put friendships at risk. The line between, on the one hand, critically analyzing and justifying one's mathematical position and, on the other, arguing and fighting with others socially is blurry. Moreover, figuring out how to disagree with the mathematical ideas of another is risky and difficult work that requires both interpersonal and intellectual skill.

Navigating these mathematical and social issues in the classroom therefore requires that students develop “a melange of social and mathematical moves [as they] struggle to figure out how to both maintain their relationships and do what the teacher has asked” (Lampert, 1996, p. 751). Importantly, if faced with the choice of “maintain[ing] a relationship or do[ing] what the teacher has asked” it stands to reason that students will likely, as Rohan demonstrated, seek to preserve their friendship. Tensions such as these necessarily influence whether and how students take up classroom opportunities to learn. Furthermore, the choices students make ostensibly further or limit the nature and level of their mathematics learning.

It seems appropriate to point out that the challenges of developing socially acceptable forms of disagreeing within a learning community are not limited to the experiences of children. For example, Grossman and colleagues (2001) rely on the term “pseudo-communities” to describe professional learning communities where teachers behave “as if we all agree” (p. 955). Ball and Cohen (1999) also argue for the importance of “unlearning the politeness norm that dominates most current teacher discourse” (p. 27). In short, learning how to work collaboratively with others in ways that are intellectually rigorous and socially palatable is complex work for learners of all ages.

A third theme that emerged among students’ reported negative experiences with classroom activities were their *difficulties understanding or explaining mathematical strategies*. Alex and Leena did not share what specifically they found difficult to understand (e.g., “it was hard to understand other people’s strategies”), however, Angela’s response provided more insight. She shared that “sometimes I get [only] a little bit of strategies that people are saying”. One possible interpretation is that Angela found it difficult to understand what other students were saying verbally as they attempted to explain their mathematical strategies. Another possible interpretation is that taking on the mathematical perspective of another individual was challenging, and that Angela did not always understand why someone approached the problem in the way that they did.

Colin reported that his difficulties aligned with the first interpretation, noting that it was difficult for him to verbally make sense of what other kids were saying. He explained that while he liked hearing the mathematical ideas of his classmates, it was not always easy for him to understand their mathematical explanations:

> C: Like, the kids, they don’t explain it that good, so I don’t understand it. But I, like, understand it the way teachers explain it.
>
> NT: So you’re saying it’s easier to understand when a teacher explains something?
>
> C: Yeah, most of the time. Some of the kids I can understand sort of. (Interview 2, March 13, 2013)

Colin later indicated that he appreciated when I revoiced the mathematical ideas of students, specifically referencing our invented classroom strategy of being the “microphone” for someone else (see Chapter 6).

> C: That’s why I like it when you do “microphone” because I can get it.
>
> NT: Oh, you mean like when I act like the microphone for one of the kids?
>
> C: Yeah. It’s easier for me to understand when you explain their idea. (Interview 2, March 13, 2013)

Jewel also acknowledged the challenges of understanding another person's explanation. However, it appeared that the task of taking on the mathematical perspective of another person was what made it difficult for her to make sense of someone else's mathematical idea.

> NT: One of the things you said to me when we talked in January was that it can be hard to understand someone else's ideas if it's different from yours.
>
> J: A lot. And if it's a lot more different than your [idea], it's really hard sometimes. (Interview 2, March 12, 2013)

She went on to share that she had developed strategies that supported her in understanding the mathematical ideas of her classmates:

> J: It got easier to understand [their ideas].
>
> NT: Why do you think that it got easier to understand?
>
> J: Like, I could wait for them to explain more, or sometimes if someone asked them questions, I could understand more. Then just sometimes you can make a connection the more you hear someone talking. (Interview 2, March 12, 2013)

Two students mentioned the increased expectation of having to explain their solution strategies as the aspect of our classroom practices they disliked. Edward, who was one of the highest performing students in the class on our weekly timed "math fact" test and who sometimes appeared perturbed when I encouraged him to share the reasoning behind his answer, wrote that he did not like having "to explain a lot and draw pictures". Emanuel expressed that "it mite [*sic*] get you frustated [*sic*] in math when you can't explain". Emanuel's comment seems to imply that he struggled with finding ways to articulate or communicate his mathematical ideas to a broader audience. Thus, it is possible that, unlike Edward who did not seem to appreciate the additional work of having to explain one's mathematical reasoning, the ambitious task of expressing one's ideas in "the language of mathematics" (Moschkovich, 2012) was the particular aspect that Emanuel found frustrating.

Two students indicated they found our classroom activities *tedious*. Specifically, Daniel stated that he found the activities "boring", and Jordan had issues with the length of time we spent working on a task. He expressed that "[it] takes a long time to get through the problem". Isaiah mentioned that he did not like it when particular students *talked too much*, or specifically, he disliked when "David talk[ed] too much". To provide context, David was a student who loved participating in our class discussions and could be long-winded in his responses. He could also be tangential or share his ideas without explicitly building on or connecting to the mathematical idea under consideration. I often struggled with knowing how to monitor David's enthusiastic contributions in ways that allowed him to participate while also moving the discussion along in a mathematically productive direction and providing opportunities for other students to participate.

It is also important to mention that David and Isaiah did not get along well, and the two of them had had several incidents with one another both in the classroom and on the playground. In my reflective journal, I noted how the nature of their personal relationship trickled into our mathematics lessons:

> Isaiah rolled his eyes and said under his breath, "why do you talk so much?" when David was explaining his ideas during our discussion today. David's explanation was especially rambly today, and it was hard to understand how his idea explicitly connected to Anisa's. Sometimes I get the feeling David contributes just to contribute, and it's become like a way to position himself. Either way, Isaiah always seems especially annoyed when David takes up time during the discussion. (January 23, 2013)

Thus, similar to how Jordan and Rohan's friendship intersected in ways that influenced their mathematics learning, the tenuous relationship between David and Isaiah seemed to influence Isaiah's willingness to learn from David.

Finally, in response to aspects of classroom practices they disliked, four students indicated they did not have anything negative to say, or as David wrote, "what I dislike is nothing".

Summary

In the previous chapter, I presented the caring practices that evolved from an integrated caring approach, and I described how these practices were designed to enable the formation of productive pedagogical relationships and enhance student mathematics learning, with particular respect to their classroom participation and emerging dispositions. The goal of this chapter was to examine students' mathematical experiences with an integrated caring approach, focusing explicitly on the emergence of productive mathematical dispositions and students' affective responses to classroom practices.

On the one hand, the findings of this chapter demonstrate that caring practices that aim to be responsive to students' individual and mathematical needs can enable student mathematical participation and facilitate the emergence of productive mathematical dispositions. Generally speaking, students came to recognize that learning mathematics required effort and persistence and came to see the importance of focusing on mathematical sense making and reasoning. Students also developed an appreciation for learning mathematics collaboratively and reported an increased willingness to participate in mathematical discussions. Important classroom resources that appeared to facilitate positive student dispositions were the use of mathematical tasks and the opportunities they afforded students to engage in mathematical sense making and reasoning. Working on solving mathematical tasks with their classmates, having multiple opportunities to participate as strategy-sharers, and considering the different mathematical ideas of classmates also seemed to support students in seeing mathematics learning as a collaborative activity of meaning-making.

On the other hand, half of the students (14 out of 28) held on to traditional views of mathematical competence and saw it as being related to high performance, doing arithmetic, or exhibiting particular classroom behaviors. Findings also reveal that students in the classroom responded to caring practices and classroom opportunities to learn in diverse ways. Factors such as peer relationships, sharing mathematical strategies in front of the whole class, and public risks of participating and making mathematical mistakes constrained the classroom participation of some students. The nature and extent of student's social relationships with one another also appeared to be particularly influential in the mathematical experiences of students. Specifically, findings indicate that students may be less likely to take another student's ideas seriously if they do not get along socially, or students may be unwilling to critique or challenge the mathematical ideas of their friends, particularly if it causes tension in their friendship.

Taken together, the findings indicate that the caring practices evolving from ICA can support the emergence of positive mathematical dispositions and increase students' willingness to participate. Yet, students within the classroom engaged differentially around these opportunities to learn and these practices did not enable all students to take up opportunities to learn in the same ways. In the final chapter of this dissertation, I weave together the analytic threads from the three previous chapters to summarize the overall findings and reflect on my experiences with the classroom-based intervention, and the role of pedagogical relationships in student mathematics learning.

CHAPTER 8: THE POTENTIAL OF CARING PEDAGOGICAL RELATIONSHIPS

In this final chapter, I reflect on how the findings of this dissertation bear on our understandings of the role of caring pedagogical relationships in the process of mathematics teaching and learning. This dissertation surfaces multiple issues that are important to consider in relation to mathematics instruction and elementary teacher practice, and also highlights the importance of the context-rich nature of the relationship building process between students and teachers. I begin by presenting a synthesis and key findings of the dissertation before moving to a discussion of some ways these findings can be leveraged to support elementary mathematics teaching. Finally, I close by discussing the limitations of this research and presenting promising areas for future lines of inquiry.

Synthesis of Dissertation and Key Findings

This dissertation was motivated by the claim that providing strong opportunities to learn is necessary but insufficient to support all students in the mathematics classroom (Gresalfi, 2009). I argued for the importance of broadening our analytic lens to examine not only whether mathematical opportunities to learn are present, but how these opportunities can be made accessible for all students in the classroom. To that end, I identified caring pedagogical relationships as a promising vehicle with the potential to serve as a relational mechanism that enables students to take up available learning opportunities within a classroom.

In the current research base, however, minimal research has explicitly examined the particular ways in which teachers build and maintain productive working relationships with their students or how these relationships positively influence student mathematical outcomes. Therefore, a central goal of this research was to understand *how* teachers build caring pedagogical relationships with their students through their mathematics instruction and examine *why* these relationships matter for student learning. Research on student-teacher relationships also often remains discipline-free and infrequently examines how subject matter shapes the ways in which these relationships are formed. Yet, the relationships between student, teacher, and content are interactive and inextricably linked (e.g., Lampert, 2001; see also Franke et al., 2007); therefore a related goal was to explore the formation of pedagogical relationships situated specifically within the discipline of mathematics.

I embarked on both theoretical and empirical lines of inquiry to provide insight into this research problem. As a first step, this dissertation addressed the need to better understand how students and teachers build relationships by providing a theoretical framework called an integrated caring approach (ICA). This framework articulated and conceptualized the work of building caring pedagogical relationships along the three dimensions of personal, mathematical, and political care. The dimensions of care illustrate how teachers can enact ambitious and equitable mathematics practices while concurrently attending to students' social and affective experiences of learning mathematics.

This study was also designed to move the theoretical notion of care closer to practice. Therefore, drawing on practitioner inquiry and design-based research, I turned to an empirical line of inquiry and operationalized the theoretical framework of ICA in the context of one fourth-grade classroom. I wanted to understand how this framework functioned as a conceptual tool for my practice, how the abstract process of caring manifested itself in my mathematics instruction, and how approaching practice from a caring approach influenced students' mathematics learning. As such, this study extended existing research in mathematics education by providing empirical evidence of how caring student-teacher relationships develop in the context of mathematics practice (cf. Bartell, 2011) and how a teacher worked to build pedagogical relationships with a classroom of diverse students on a collective level (cf. Hackenberg, 2005b; 2010).

The data from this study support the following five general results. First, the caring relationships I developed with students through ICA served as a pedagogical tool that strengthened my mathematics instruction. Specifically, approaching mathematics practice from the multiple lenses of personal, mathematical, and political care provided opportunities for me to learn about my students as individuals and mathematics learners. Subsequently, I leveraged my increasing knowledge of students to support student mathematics learning. Developing relationships with students enabled me to attend to students' emerging mathematical identities and dispositions, their classroom experiences, and provided insight into how to create classroom conditions that made it more likely for students to engage and participate in mathematics lessons. For example, gaining insight into students' mathematical experiences through student surveys, interviews, and journal entries provided me with insight into how I could refine learning opportunities to facilitate student participation and led to changes in my overall pedagogical approach during the intervention.

Second, findings indicate that the process of caring manifests itself in a teacher's mathematics instruction in direct response to her perceptions and developing awareness of the mathematical and personal needs of the students under her care. Specific to this study, data illuminates four particular practices and strategies I used to build caring relationships that explicitly aimed to advance student mathematics learning: making content accessible to students, explicitly disrupting students' traditional perceptions of the discipline and mathematical competence, establishing a collaborative classroom context, and remaining sensitive to the needs of individual students as well as the collective class. Although the framework of ICA and the three dimensions of care guided my approach to mathematics instruction, my pedagogical choices throughout the intervention were fundamentally shaped by a sense of responsiveness to the fourth-grade students and my on-going interpretations of the fourth-grade students and the classroom context. Therefore, the four caring practices that emerged in this study represent an analytic reintegration of the dimensions of personal, mathematical, and political care. In other words, the caring practices that evolved from the framework depict how the three dimensions of care worked both simultaneously and alongside one another in "real-time".

The results of this study are therefore an important reminder that the constituent parts of a decomposed practice may look quite different when enacted in the classroom. On the one hand, decomposing practices is useful for the purposes of making it learnable for novices (Grossman et al., 2009), on the other, it does not explicitly support teachers as they grapple with problems of enactment in the classroom and "leaves troublesome gaps, rendering the most fundamental aspects of the work invisible" (Lampert, 2001, p. 28). As such, representations of enacted practice, such as the four caring practices, are also needed to support teachers as they navigate and negotiate situational problems that arise during interactive teaching moments in the classroom.

Third, analysis indicates that the caring practices in this study concurrently fostered the emergence of positive mathematical dispositions among fourth-grade students and supported the formation of caring pedagogical relationships. Repeated engagement with the four caring practices during the intervention broadened students' traditional views of mathematics and increased student willingness to participate in mathematical discussions. Students' increased willingness to engage and participate in mathematics activities can also be interpreted to mean that students received the enactments of care I offered through the caring practices. This finding converges on existing studies that demonstrate students who feel a connection to their mathematics teachers display increased effort (Muller, 2001; Stipek, 2006) and are more likely to engage in mathematical risk-taking and develop more positive orientations towards the discipline (Stipek et al., 1998). In addition, creating a learning environment focused on mathematical sense-making and reasoning, where multiple ways of "knowing mathematics" were appreciated, and assigning mathematical competence to specific students also supported student engagement and participation. In short, "there were many more ways to be successful, so many more students were successful" (Boaler, 2006, p. 78).

Fourth, findings reveal that the mathematical experiences among fourth-grade students in the classroom varied. Specifically, students responded to my mathematics instruction and classroom learning opportunities in diverse ways. These differences appeared to be influenced by students' conceptions of themselves as learners, their personal learning preferences, conceptions of the discipline, and the nature of peer relationships within the classroom. Factors such as the large class size and perceived public risks of participating and making mathematical mistakes also constrained the classroom participation of some students. This result serves as a reminder for both researchers and teachers that students' perceptions of classroom practices and mathematical experiences within a single classroom vary considerably. It lends credence to Esmonde's (2009) call for remaining sensitively aware that different students may interpret practices in different ways, depending on one's social, racial, and cultural background. Therefore, as the analysis in this study illustrates, it is important to recognize that classroom practices and particular ways of engaging in mathematical activities are not common experiences for all students nor will all students necessarily feel comfortable taking up these ways of participating.

Finally, the results suggest that social and affective dimensions of the learning process largely influenced fourth-grade students' mathematical experiences and the ways in which they took up classroom learning opportunities. Specifically, students' decisions on whether and how to participate in mathematical activities were rooted in their perceptions of the social climate of the classroom or their social relationships with one another. For example, students' reluctance to share their mathematical strategies with the class stemmed from their reluctance to admit uncertainty or make a mathematical mistake in front of their peers. Students were also less likely to take one another's mathematical ideas seriously if they did not get along well socially with the person making the contribution, and students faced challenges in knowing how to critique or challenge the mathematical ideas of their friends, particularly if it caused tension in their friendship. This work, therefore, contributes to the growing body of research in mathematics education (e.g., Gresalfi, 2009; Gutiérrez, 2012; Hackenberg, 2005a, 2005b, 2010) specifying that social, affective, and motivational dimensions of mathematics learning – frequently categorized as "non-cognitive" or "non-mathematical" dimensions of learning in existing studies – are in fact inextricably and centrally related to the process of learning mathematics.

Implications

In sum, this dissertation indicates that caring pedagogical relationships positively influence student mathematics learning and has the potential to support more equitable student outcomes in the classroom. The findings from this study carry relevant implications for both practitioners and elementary teacher educators, and I present relevant recommendations below.

Implications for Practitioners

The findings of this study illuminate particular teaching practices that elementary teachers can draw on as they work to establish and maintain productive relationships with their students that explicitly aim to advance their mathematics learning. In the section below, I share three particular practices and pedagogical moves teachers can incorporate into their instruction to build caring relationships with their students: being explicit with students about how to participate in mathematical activities, getting to know individual students and their mathematical experiences, and creating a learning community for students to take social and intellectual risks. Though I present three practices below, there are conceivably other caring practices teachers could draw on to enable the formation of pedagogical relationships based on this study (see analysis in Chapter 6 for further ideas).

In this study, explicitly instructing students on how to engage and participate in mathematical activities appeared to enable students' participation and provide students with a clear vision of what it meant to be a doer and learner of mathematics. Therefore, pedagogical strategies such as coaching or offering students focused and specific praise are ways teachers can concurrently enable students' mathematical participation and provide affective support to students as they learn to engage in novel and socially risky practices. Research on equitable mathematics practices indicates that implicit norms in the classroom may be novel to particular groups of students and unintentionally marginalize student participation (e.g., Boaler & Staples, 2008; Delpit 1995; Murrell, 1994). Therefore, making explicit statements or occasionally holding open and direct classroom discussions with students could support them in developing more productive conceptions about what counts as doing mathematics and facilitate more mathematical risk-taking and persistence. At first glance, these classroom discussions may appear to detract from important instructional time, however, dialoguing with students about these issues provide teachers with opportunities to gain insight into students' mathematical experiences as well as teach their students about the learning practices students need to take up to deepen their mathematical understandings.

To build caring relationships, it is important for teachers to incorporate instructional activities that afford opportunities to get to know individual students and their mathematical experiences within the classroom and use this knowledge in service of promoting positive student mathematical outcomes. Developing productive working relationships requires teachers to be responsive to students' personal and mathematical needs, and to be responsive, teachers first need access to students' perceptions of classroom practices. For example, listening to students' narratives of their mathematical experiences through individual interviews provided me with insight into how to refine learning opportunities and construct classroom conditions that would make it more likely for students to engage and participate. Therefore, the use of instructional tools such as interviews, surveys, or journal entries provide teachers with a window into students' views of mathematics and their conceptions of themselves as mathematics learners. Subsequently, teachers can leverage this knowledge to plan, facilitate, and reflect on their mathematics lessons and refine learning opportunities to make it more likely for students to engage and participate. Gaining insight into students' conceptions of themselves as mathematics learners also supports teachers in knowing which students to position competently and whose mathematical strategies and ideas to highlight during whole class discussions.

Learning new practices and taking up new ways of participating in learning mathematics involves personal and intellectual risk-taking (Cohen, 2005). Students who feel their classmates are supportive and encouraging may be more willing to take intellectual risks. Therefore, teachers should prioritize the importance of building a sense of community within the classroom – both among students and between students and teacher – and work to establish a climate that enables students to learn collaboratively and productively with one another. Promoting learning as a collaborative endeavor within the classroom, and supporting students in seeing one another as important intellectual resources is one way teachers can establish a productive learning community. For example, teachers can provide opportunities for students to share their mathematical ideas with one another in the classroom or explicitly make connections between students' mathematical ideas during classroom discussions. In this way, teachers also support students in developing caring relationships with one another (Bartell, 2011).

Another way teachers can support the formation of a caring learning community is by reframing mathematical mistakes as “desirable contributions” (Staples, 2008). Making mistakes in a public space presents both social and emotional risk, particularly if one believes making mistakes is an indicator of one’s (in)competence rather than an productive and natural aspect of learning, and as some of the fourth-grade students reported in this study, the risk of making public mistakes can inhibit students’ willingness to participate. Teachers can frame mistakes as markers of student competence or offer students opportunities to “revise their thinking” (Lampert, 2001) as strategies to increase student engagement and establish a safe and trusting environment to learn mathematics. Doing this could enable more students to share their mathematical ideas and increase students’ participation during mathematical discussions.

Implications for Elementary Teacher Education

In addition to supporting teachers’ instructional practices, the findings from this study can be used in elementary teacher education and professional development to support practitioners in learning how to build pedagogical relationships with their students that are both academically and interpersonally strong. The purpose of this dissertation was not to provide a generalizable model of how teachers should build pedagogical relationships with their students, but rather to show how the framework of ICA guided and served as a resource for my work with one class of fourth fourth-grade students. Therefore, the framework developed in this dissertation can be utilized as a conceptual tool to support other teachers in developing productive working relationships with students while aiming for ambitious and equitable mathematical outcomes.

Existing research demonstrates that both prospective and practicing elementary teachers view caring for students as a central aspect of their work (Goldstein, 2002; Hargreaves, 2000; McBee, 2007; Vogt, 2002), and that the notion of care is a salient lens through which elementary teachers frame their interactions with their students (Kennedy, 2005; Phillip et al., 2000). The theoretical lens of an integrated caring approach, therefore, is a potential way to leverage elementary teachers' caring orientations and support them in developing caring relationships with students *through* their mathematics instruction wherein subject matter learning remains central in the process of forming these relationships. More specifically, ICA illuminates the relational aspects of attending to student mathematical thinking and because elementary teachers are particularly motivated by their interest in and accountability to students' social and emotional development, this framework provides insight into how elementary teacher education can support teaching practices that respond to students' affective needs in conjunction with, and not at the expense of, providing strong mathematical learning opportunities.

The work of teaching is complex and multidimensional, and teacher education scholars argue for the need to decompose complex teaching practices in order to specify key components of the work so they can be taught to and practiced by pre-service teachers (Grossman et al., 2009). The framework of ICA, and the three dimensions of care in particular, identifies and makes visible the work involved when striving to form interpersonally and academically strong relationships with students. Much of the work of elementary teachers consists of getting to know students as individuals, helping students come to understand themselves, and supporting them in learning how to work productively and collaboratively with others in the classroom. However, a fundamental aspect of a teacher's work is to support students' academic learning as well. ICA organizes the multiple aspects involved in mathematics teaching and can be used to support teachers in planning lessons and attending to the three dimension of care in their practice. The lesson planning framework used in this dissertation provides an explicit outline for how teachers can attend to students' mathematical thinking, provide equitable learning opportunities, and attend to students' socio-emotional learning experiences through one's mathematics lessons. In addition, parsing out the work of building caring relationships along the three dimensions of care provides teachers and teacher educators with specific language to describe and analyze how one begins to develop productive student-teacher relationships in service of student mathematics learning.

Finally, the framework of ICA can be utilized to support elementary teachers in developing more sophisticated and nuanced conceptions of care in methods courses or professional development. As the findings in this dissertation confirm, learning how to build and maintain productive working relationships with the students in one's care is complicated and purposeful work (Grossman et al., 2009, Labaree, 2000), yet the invisible nature of this work (Lampert, 2001) can lead to the assumption that forming caring relationships is a natural rather than learned skill. For example, some elementary pre-service teachers hold underdeveloped notions of care and tend to fall back on sentimental versions when describing the importance of care in their teaching practices (Goldstein, 2002). Because ICA presents a multidimensional view of the construct of care, the framework can be used to problematize teachers' sentimental notions of care and support teachers in identifying other and less recognized forms of caring to promote positive student learning outcomes. For example, the dimensions of mathematical and political care suggest that teaching strategies such as framing mathematical mistakes as desirable contributions or prioritizing student mathematical sense-making and reasoning are productive forms of caring for students because it creates a supportive learning atmosphere where multiple ways of knowing mathematics are honored.

Limitations

As I discussed more thoroughly in Chapter 4, being in the role of teacher-researcher meant that my subjectivities were front and center in this study. To be clear, I do not see my position as a pure limitation, and there were many affordances to viewing practice from the inside (Ball, 2000). But it is important to acknowledge there may be unexamined aspects of my research that were hidden from my view and limit the scope of the findings I present here. Another limitation emerges from methodological issues of analysis. That is, the student experiences I report here are filtered through my interpretive lens, and while I have attempted to honor students' voices in my analysis, my findings are not intended to reflect students' "lived experiences" (Van Manen, 2010).

To this end, there were a number of students in the classroom whose voices were less visible than others due to the available interview data. I speculate that the findings of this study may have been different if there had been an opportunity to interview each student in the classroom. I do not know if the findings would be significantly different, but it is important to acknowledge there are alternative student experiences that were not fully captured in this study. I also did not explicitly analyze how students' identities of race, class and gender (among other possible markers of identity) shaped our developing relationship or students' mathematical experiences in the classroom, yet I have a strong hunch that these were influential forces within the classroom, and there remains a need for research that attends to these interactions more closely. Finally, although the findings from this study gives an example of how fourth-grade students developed more positive mathematical dispositions through their engagement with a 12-week intervention, these dispositions are not necessarily enduring, and more work is needed to examine how positive mathematical dispositions are sustained over an extended period of time.

Future Research

The findings of this dissertation reveal lines of inquiry that can be taken up and extended. The principal finding that caring relationships positively influence student mathematics learning points to the importance for additional research that provides nuanced depictions of what caring teacher-student relationships look like in mathematics classrooms and identifies the particular ways this relationship contributes to students' opportunities to learn mathematics. While progress has been made in recent years, the role of caring student-teacher relationships remains largely underexamined in the field of mathematics education. Yet, "the very notion of teaching as a relational act is a theoretical statement" (Schoenfeld & Kilpatrick, 2008, p. 27), and research that continues theorizing about the role of caring pedagogical relationships in the process of learning mathematics is needed. This study focused on the development of caring relationships in the context of one elementary classroom, however, future research should consider how teachers establish and maintain relationships with their students in middle grades and secondary classrooms.

Additional studies could identify instructional strategies that minimize the personal and social risks involved with ambitious mathematics teaching so that these risks do not negatively interfere with students' mathematics learning. The findings here indicate that peer relationships and social interactions around mathematics influenced whether and how students interacted with mathematical activities. The perspectives of the fourth-grade students remind us that instructional practices that strive for ambitious student outcomes take place in the context of "the buzzing, blooming confusion of real-life settings" (Barab & Squire, 2004, p. 4). As Rittenhouse et al. (1996) observe:

> the school classroom is a place where friends are made and lost, where identity is developed, where pride and shame and caring and hurting happen to kids…mustering evidence to prove that an assertion is right or wrong is not a decontextualized learning activity. In the classroom, mathematical argument is done with and to the same people one plays with, eats lunch with, lives next door to, or has a crush on. (p. 759)

As illuminated in this study, adopting novel ways of interacting both socially and mathematically raises significant affective tensions in the learning process, and all students may not be "willing participants" (Cohen, 2005). What is more, taking on these new roles means students may need to develop new mathematical identities as they engage in these practices as well, identities that could conflict with the individuals students are striving to be seen as. As the field moves towards identifying ways to support teachers in implementing ambitious mathematics teaching in the classroom, it is important to concurrently identify strategies that gradually enculturate students to these new practices and support them in developing mathematical identities that align with, rather than work in opposition to, the other identities students bring with them to the classroom.

Future work could also focus on the particular ways the broader school and district contexts potentially support or hinder the development of caring pedagogical relationships, and how teachers negotiate these demands in their practice. In this study, I focused on the ways pedagogical relationships were developed within the classroom context, however, my analysis revealed traces of how district policies, namely the

Illuminate benchmark system, negatively impacted my practices within our classroom, and by extension, the formation of caring relationships. It is important to recognize that student-teacher relationships are formed and nested within the broader socio-political contexts of schools (Gutiérrez, 2013). In *The Challenge to Care in Schools*, Noddings (1992) points out that, “the structures of the current schooling work against care, and at the same time, the need for care is perhaps greater than ever” (p. 20). Against the backdrop of the current educational climate of standardized testing and high stakes accountability, several scholars echo Noddings’ call and argue that the narrowed concentration on measurable academic outcomes has led to more school and academic disengagement, particularly among at-risk students (Goldstein, 2002; Hargreaves, 2000; Stipek, 2006). Therefore, future research should attend more closely to the particular ways the school environment shapes the work of building productive student-teacher relationships that aim for ambitious and equitable mathematical outcomes.

Finally, the results indicate there may be utility in problematizing how the construct of mathematical opportunity to learn (Hiebert & Grouws, 2007) is currently conceptualized in the field of mathematics education. My analyses converge on Gresalfi’s (2009) argument that providing strong opportunities to learn will not, in and of itself, ensure that these learning opportunities will be taken up by all students. Therefore, it stands to reason that making a theoretical distinction between classroom opportunities that are *available* and opportunities that are *realized* will open up new and valuable lines of inquiry. More specifically, what constitutes an opportunity to learn? If classroom opportunities are not recognized as such by students, should they be considered legitimate “opportunities”? Additional research that extends the construct of “opportunity to learn" and identifies classroom mechanisms that lead students to take up opportunities to learn seems to be particularly consequential when working towards equitable student outcomes in mathematics classrooms.

Concluding Remarks

In sum, this exploratory study provides evidence that caring relationships between students and teachers can positively influence student mathematics learning and support the emergence of positive mathematical dispositions. Recognizing that the process of teaching and learning mathematics is a social, interactive, and relational practice suggests that research efforts should attend more closely to the salient role caring student-teacher relationships play in mathematics classrooms and in students' mathematical experiences. As Franke and colleagues (2007) reason:

> We recognize that building this type of relationship with students will not resolve all of the equity issues in mathematics classrooms. We recognize the societal, structural basis for much inequity. However, we (as do others) see that building different kinds of relationships and opening different opportunities for participation and practice can lead to using mathematics to help transform what happens for students of color, English language learners, students living in poverty, and other marginalized groups. (p. 249)

Much remains to be learned about how teachers establish productive working relationships in mathematics classrooms and how they leverage these relationships to support positive mathematical outcomes. The findings from this study contribute theoretical and empirical insights to the field and provide important evidence that caring student-teacher relationships are central, not peripheral, in the process of teaching and learning mathematics.

Appendix A: Guiding Framework for Lesson Plans

Original Source: Jackson & Cobb (2010). Refining a Vision of Mathematics Instruction to Address Issues of Equity

<table>
<tr><th>Mathematical Care</th><th>Political Care</th><th>Personal Care</th></tr>
<tr><td>Teacher poses a cognitively demanding task</td><td>Teacher holds a whole class discussion aimed at supporting students’ 1) understanding of the cultural suppositions inherent in the task scenario (Boaler, 2002, Ladson-Billings, 1995) and 2) development of situation-specific imagery of the mathematical relationships described in the task statement (Thompson, 1996).</td><td>Teacher embeds the task in a context that students find familiar or interesting in order to “foster a more positive emotional relationship” (Rosiek & Beghetto, 2009, p. 186) between the student and the content
Teacher chooses appropriate problems to pose based on students’ previously demonstrated mathematical reasoning (Hackenberg, 2010) and attends to how students use mathematics across home and school settings (Gresalfi & Cobb, 2006)</td></tr>
<tr><td>Students work on solving the task either individually, partners, or in small groups</td><td>Teacher guides students’ development of small group interactions that are characterized by multivocal interactions. For example, once students begin to share individual explanations, teacher listens to small group interactions and interjects to maintain the dialogue between students (e.g., ask questions or make comments to support students to verbalize solutions, listen to others’ solutions, and reach consensus about solutions) (Yackel & Wood, 1990).</td><td>Teacher attends to student emotional responses and makes efforts to 1) foster constructive emotions by offering reasons why the content is worthwhile to learn or 2) mediate an unconstructive emotional response to content by drawing attention to these emotions and assuring students it is “not as bad as it seems” (Rosiek, 2003, p. 407)
Teacher encourages students to use one another as resources and facilitates ways for them to develop respectful working relationships with one another in order to develop a supportive and safe learning community (Noddings, 1984; Bartell, 2011)</td></tr>
<tr><td>Teacher leads a whole class discussion of the students’ solutions</td><td>Teacher presses and supports students to engage in calculational discourse (e.g., the reasons for carrying out solution processes also become an explicit topic of conversation, students’ explanations are grounded in situation-specific images of the key mathematical relationships. This requires that the teacher renegotiates with students sociomathematical norm of what counts as an acceptable solution (Cobb et. al, 2001).</td><td>Teacher leads discussions in ways that arouse student interest – finding ways to connect with the personal lives of students (Rosiek, 2003) and how mathematics might be used for their own lives and purposes (Noddings, 1984).
Teacher seeks the involvement of the student, not only the solution or answer itself (Noddings, 1984), thus attends to student emotional responses during the discussion.</td></tr>
<tr><td colspan="3">Applies to each phase
Teacher explicitly negotiates with students the norms of participation in each phase of the lesson, including what students will be held accountable for in each phase of the lesson (Boaler & Staples, 2008).
Teacher assigns competence (e.g., teacher publicly highlights or marks a contribution made by a student who is typically quiet or marginalized) (Boaler & Staples, 2008).
In cases where students use informal or nonmathematical language to explain their reasoning, the teacher rephrases or revoices their explanation in terms of formal mathematics language (Moschkovich, 1999, 2002).
Teacher dialogues with students in ways that facilitate a connection between the two parties – seeking to understand students’ relationships with content, including what their goals are and how mathematics may connect with their lives (Bartell, 2011; Noddings, 1984).</td></tr>
</table>

Appendix B: Partial List of Tasks

(names of students and names of some contexts have been changed)

Isaiah, Colin, and Sofiya go to the Oakwood School Fall Festival and win 320 tickets all together. They decide to split the tickets between the three of them. Will they each get an equal amount of tickets? How many tickets will each person get?
Oakwood School has 595 students. All grades have the same number of students. How many students are in each grade?
Kamari has 327 flowers to plant in the Oakwood School garden. He wants to plant the same number of flowers in 3 rows. How many flowers will be in each row? Will Kamari have any extra plants left over?
Line AB is parallel to line CD. Line CD is parallel to Line EF. Line EF is perpendicular to Line AB. Is this possible? Explain your reasoning.
Leena drew three line segments. Two line segments share a common endpoint and both intersect the third line segment. Make a drawing similar to what Leena drew. Explain your reasoning.
Melissa drew a polygon using the line segments AB, BC, CD, and DA. What kind of polygon did Melissa draw? How do you know this is what Melissa drew?
The Oakwood intermediate grade students are going on a field trip to the San Francisco Zoo. 4 school buses will transport the students to the zoo. The same number of students will ride on each bus. If there are a total of 412 students going, how many students will ride on each bus?
I sat down to watch TV and when I looked up at the clock, I noticed that the hands of the clock made an obtuse angle. What show might I be watching? What time might it be?
Stephen had a dozen eggs. He dyed five of them purple and he dyed the rest of them red. What fraction of the eggs are red? Explain your reasoning.
Sirenity, Edward, Lacie, and Angela want to share 3 brownies equally. How much will each of them get? Explain your reasoning.
Sirenity, Edward, Lacie, and Angela want to share 10 brownies equally. How much will each of them get? Explain your reasoning.
Emanuel drank 17/4 cups of milk. Cindy drank 4 ½ cups of milk. Who drank more milk? Explain your reasoning.
Put the following fractions in order from least to greatest. 1/3, 1/8, 1/5, 1/10. Explain your reasoning.
Would you rather play outside for ½ of an hour, ¾ of an hour, or 2/10 of an hour? Explain your reasoning.
Daniel has a box of 10 pencils. Some are Smencils and some are Dixons. What combination of pencils might be in Daniel's box? How could you use fractions to represent the amount of Smencils and Dixons in the box?
Write a fraction and a decimal to show the amount shaded in the model. Explain why your fraction and decimal represent the same amount.
Which number belongs in the blank? 8+4 = __+5. How could represent this equation using a mathematical model?
Dude had 27 erasers. He bought 2 more erasers at the student store. Then he gave the 2 erasers he bought to Kyler. Does the number sentence below represent the situation in the problem? Explain your reasoning.
Anthony's secret number is 4 times as large as Carol's. What could Anthony's secret number be? What would Carol's number be?
There are 3 cubes and 1 cylinder on the balance below. Each of the cubes has the same weight. Which shapes weighs more: the cube or the cylinder? Explain your reasoning.
Four families are going on a trip to Disneyland. They plan to carpool together from Sacramento to Los Angeles. There are 6 people in each family. Each car holds 5 people. How many cars will they need for the trip?

Appendix C: Student Math Survey

Name _______________________________ Date ____________

A. I like doing math.

most of the time **some** of the time **a little** bit **never**

B. I have trouble learning new math strategies.

most of the time **some** of the time **a little** bit **never**

C. I am good at solving math problems.

most of the time **some** of the time **a little** bit **never**

D. I like to share my math strategies in class.

most of the time **some** of the time **a little** bit **never**

E. My classmates can learn from my math strategies.

most of the time **some** of the time **a little** bit **never**

F. Math is hard for me.

most of the time **some** of the time **a little** bit **never**

G. Listening to other students' math strategies helps me.

most of the time **some** of the time **a little** bit **never**

What does it mean to be good at math?

___

___

___

Appendix D: Semi-structured Student Interview Protocol

(interviews will last between 10-15 minutes and questions will be used as a guide)

Thank you for being willing to talk with me about your experiences learning math. It's really helpful for me to get a sense of how you like to learn math, and it will help me know how to teach you better. There are no right or wrong answers. I'm interested in hearing what you think and how you like to learn. Also, it's okay if there are any questions you don't feel like answering or if you decide you don't want to answer any more questions. You can let me know at any time by saying something like "pass" or "I don't feel like talking anymore".

- Do you like learning math? Why or why not?
- What do you think it takes to be good at math?
- Do you think everyone can be good at math? Why or why not?
- Can you tell me about some of your experiences learning math in school? How have you learned math in K-3 grades? Were there any activities you liked? Disliked? Why?
- In what ways are you good math? What would you like to get better at doing?
- How do you feel about participating in math discussions with the class?
- Do you like explaining your ideas? Does explaining your ideas to other kids help you learn?
- Do you like listening to the ideas of the other kids? Why or why not? Does it help you learn when you hear their ideas?
- Do you think kids can get better at learning math? What kinds of things would someone need to do to get better at doing math?
- Pretend you were the math teacher for the day. What kinds of activities would we be doing? Would the kids be working alone, in partners, or small groups? What kinds of things would you be doing as the math teacher to help the kids learn?

Appendix E: Coding Framework for Instructional Practices

Making Mathematics Accessible

- Facilitating task launch
- Making participatory expectations explicit
    - Focused praise
    - Coaching
- Mitigating social risks of participating
    - "Microphone"
    - Strength in numbers
    - Rehearsals

Redefining What it Means to be a Mathematics Learner

- Promoting sense-making and reasoning
    - Recurrent use of tasks
    - Press for explanations
    - Negotiating student assessments
- Distributing mathematical authority
- Assigning competence
- Making explicit statements

Building a Sense of Community

- Implementing a curriculum of empathy
- Use of classroom rituals
- Facilitating dialogue
- Spending time together

Creating Micro-opportunities to Learn

- Confirming students
- Selective seating

Appendix F: Dude's "Hello, World" Writing Activity

Hello, world.

I am ____________________

I am a student, a child, & cool.

Even though I am usually confident, sometimes I feel nervus.

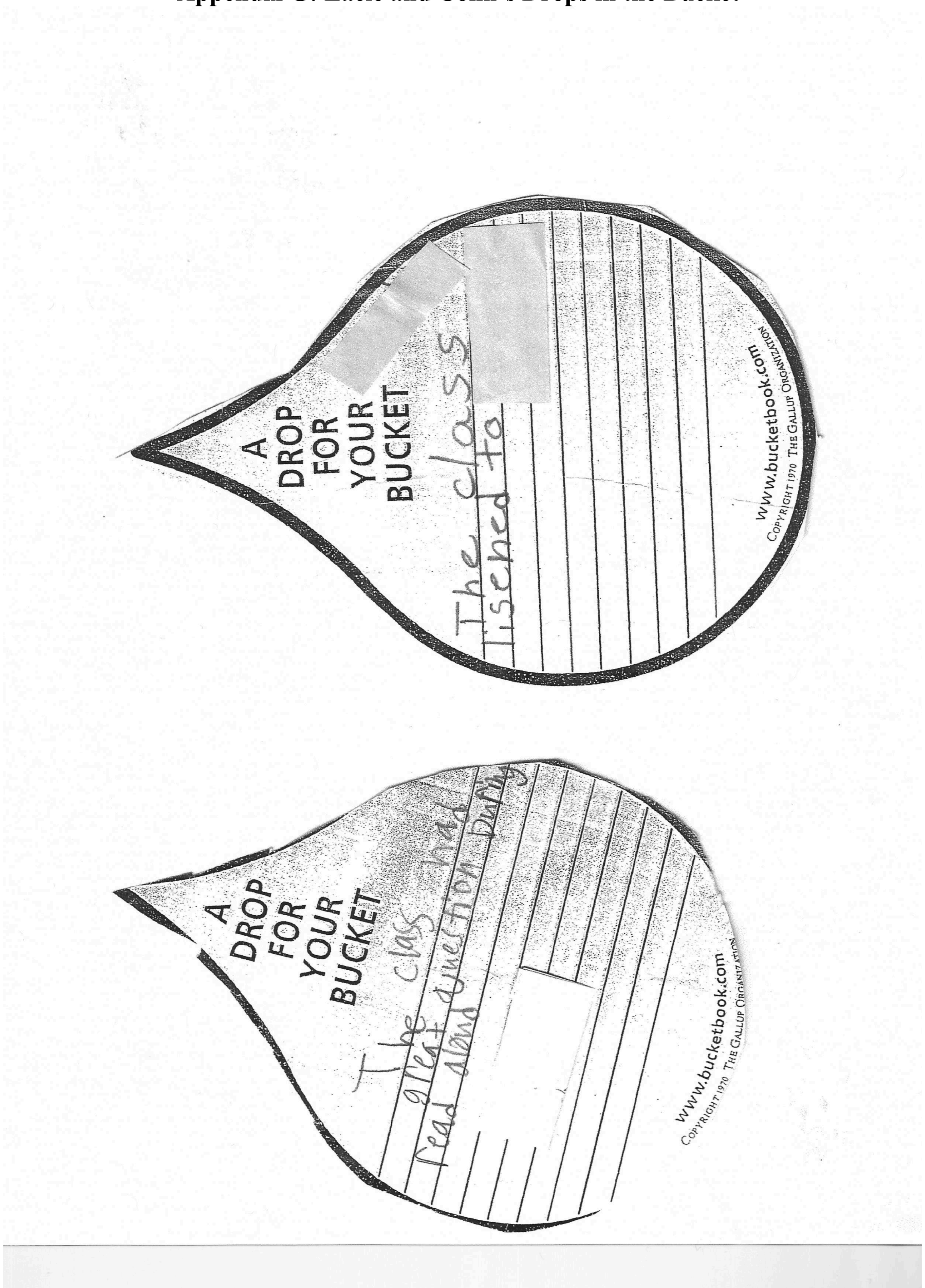
One thing I want my colleagues to know about me is that I am awesome

I wish people told me to calm down more often..

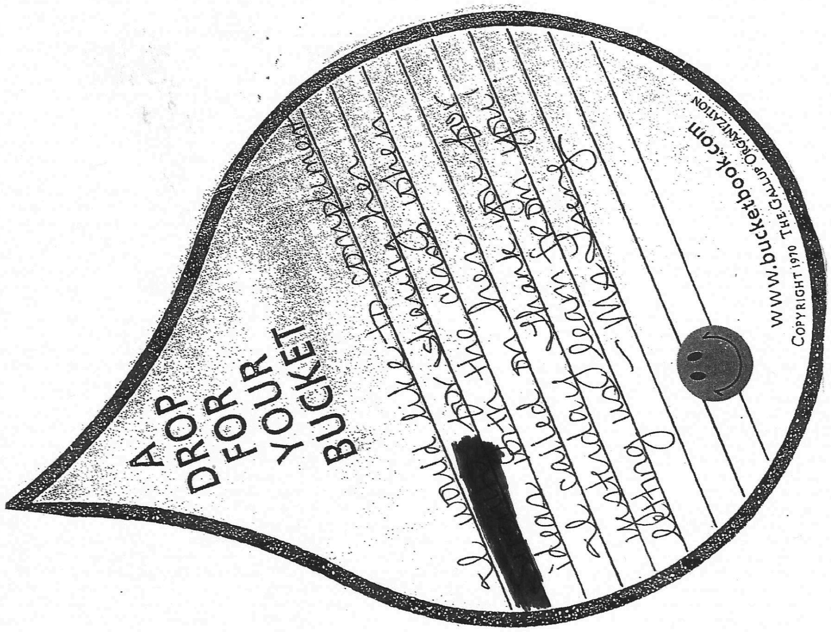
My greatest ambition is to open my own wrestlin houg

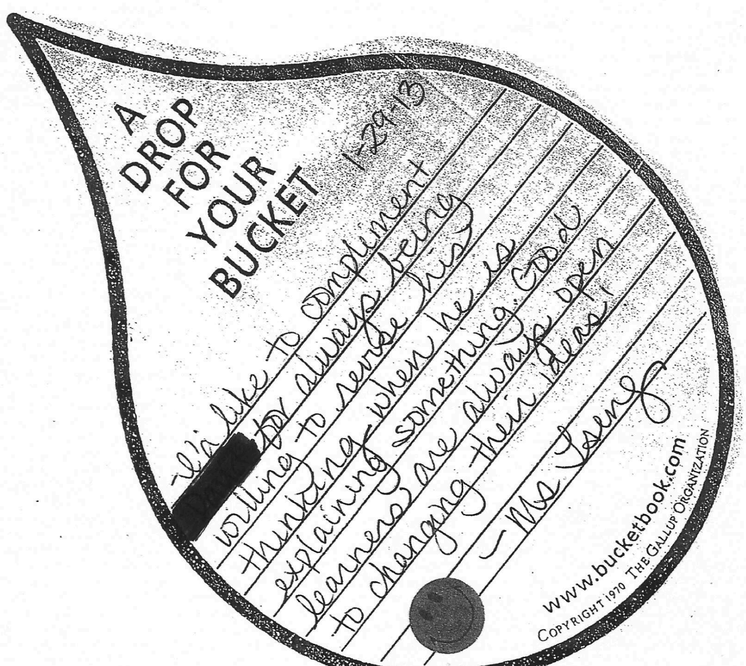
I want to live in a world where everyone is diffrent from each other.

Appendix G: Lacie and Colin's Drops in the Bucket



Appendix H: My Drops in the Bucket to Sirenity and David





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