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MATHEMATICS PEDAGOGY IN THE POSTSTRUCTURAL MOMENT:
A RHIZOMATIC ANALYSIS OF THE ETHOS OF SECONDARY
MATHEMATICS TEACHING IN AN URBAN SETTING

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

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* * * * *

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1998

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This ten-week ethnographic research deals with the structure of complexity of four secondary mathematics teachers’ work and lives in an urban setting. It is argued that a mathematics teacher’s work and culture, in general and in its multiplexity, is wed to a plurality of competing factors and changing contexts that redound from the various contradictions, conflicts, assimilated contraries, and double binds that a teacher negotiates daily. Provisional findings and interpretive analyses were obtained through interviews, document analysis, survey and grounded questionnaires, persistent observations, and the rhizomatic attitude of working not for or with the teachers but “between” them.

Two research questions were investigated:

1. What does it mean to teach high school mathematics in an urban setting at the present time?

2. To what extent do pedagogical practices subjectify students into a way of thinking about/acting/doing mathematics in the classrooms?

The methodological framework employed is poststructural ethnography in that it seeks a critical ontology of “how things are,” problematizing the acritical status quo of everyday ideas in the current regime of mathematics pedagogy. The innocence of mathematics teaching is problematized. Recent reform rhetorics including the rhetoric of the *Curriculum and Evaluation Standards* with its promise of utopia and
the rhetoric of meaningful (and authentic) learning of mathematics in the
constructivist movement are (re)assessed vis-a-vis the constraints of urban
mathematics teaching.

Underlying the theoretical position that is pursued in this work is Deleuze and
Guattari’s *rhizome*. The rhizomatic framework has a teacher’s regime of truth
disjunctively synthesized with many factors such as the social context of teaching,
her/his personal epistemologies, beliefs and practices, the (implicit) meta-
revolutionary changes in school mathematics, and poststructural readings of the
discourse of mathematics teaching.

Findings of this study include: (1) the social context serves as a mediating
difference between a mathematics teacher’s espoused and enacted theories and
beliefs; (2) there exists a “gendered” deployment of school mathematics teaching
based on relational and impersonal modes of epistemology; (3) teachers with few or
narrow meaningful mathematical experiences tend to constrain the meaningfulness of
learning and teaching; (4) teachers’ low clientele perception leads to the
underestimation of their students’ mathematical power and needs; (5) a conflict seems
to exist between the ethos of mathematics teaching and the “new” ethos of schooling;
(6) patterns of absenteeism make it extremely difficult for teachers to implement
curriculum innovation, and; (7) teachers tend to develop a sense of isolation. The
study also includes ways in which a student’s math subjectivity is constructed through
a Foucauldian genealogy of the deployment of mathematics teaching.
dedicated
to Mr. Jack, Ms. Lynch, Ms. Prahst, and Mr. Taft
and especially
to mom and dad
for wonderful moments of life
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Douglas Owens has supported me all the way and has provided enough space for my self-transformation. Patti Brosnan saved me from too many difficult moments of indecision about my own work and just about anything that had to deal with life.

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I learned much from the conversations I have had with Betsy McNeal, who was never afraid to say whether or not I made sense.

Truly a (wo)man for others, Fr. Ben Nebres, S.J., has been very supportive of my work.

The last person on my list knew just what it meant to be the best, whose absent presence made this work "absolutely" meaningful.

This work is a result of the generosity of these people. I know words fail ...

Amor fati.
VITA

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CHAPTER 1

WITHIN THE POST(STRUCTURAL): THEORIZING
THE ETHNOGRAPHY OF MATHEMATICS CLASSROOMS

But is there an inside that lies deeper than any internal world, just as the outside is farther away than any external world? The outside is not a fixed limit but a moving matter animated by peristaltic movements, folds and foldings that together make up an inside: they are not something other than the outside, but precisely the inside of the outside.

Gilles Deleuze
Foucault

We live within a tense but exciting moment of great ferment in social science research. The so-called postmodern turn has led to a social science that adheres to poststructuralism -- a kind of “structural openness” (Judith Butler in Butler and Ernest Laclau, 1997, p. 9) -- in which various epistemological ruptures engender different ways of thinking about being and beings, social practices, and other objects of knowledge. Jonathan Culler’s (1988) “reinvent(ing) reading so that previously unseen inscriptions may be read” (p. xv.) seems to describe the practice of poststructural theorizing.

Poststructural theorizing situates its problematic purposefully in marginal spaces, in the various interstices of a phenomenon or an object of knowledge.
Poststructural theorizing involves a kind of reading that problematizes what we are, what we do, and the world we live in (Foucault, 1986, p. 10). More than that, the “openness” of poststructural theorizing asserts a philosophy that “find(s) out in what way and to what extent it would be possible to think differently” (Georges Canguilhem, 1992, p. xv). The performative aspect of poststructural theorizing and philosophy lies not entirely in a kind of reading with a difference, but in the development of meditative thinking, in Heidegger’s sense. Martin Heidegger writes:

Meditative thinking demands of us not to cling one-sidedly to a single idea, nor to run down a one-track course of ideas. Meditative thinking demands of us that we engage ourselves with what at first sight does not go together at all. (Heidegger, 1969, p. 53)

Such engaged thinking leads to a release towards the phenomenon (or simply a thing or a concept) under investigation and thus, is always already predisposed to deconstruction through processes of reversal and of displacement. Furthermore, because we cannot establish an epistemological completeness, then the theorizing is always already open to this mystery of incompleteness. This is the genesis of this dissertation on the ethnography of mathematics classrooms: the dissertation is one that is already situated “in the middle of things and not at their origin and their end” (Jean-Luc Nancy, 1996, p. 108). Which means to say that a meditative thinking about the mathematics classrooms involves two processes: we release ourselves in the “already” existing

---

1 Following Heidegger’s (and Jacques Derrida’s) concept of sous rature, I insist that the word “philosophy” is to be held under erasure: it is “inadequate yet necessary” (Madan Sarup, 1993, p. 33) which also means to say that we remain suspicious as we employ it.

2 Heidegger introduced this concept of “meditative thinking” in connection with the question concerning the essence of technology.
circumstances and we do not expect a closure mainly because we cannot claim finality of thought, that is, any analysis we make emerges from our interpretations.

How do we, then, actualize a Heideggerian meditative thinking about social phenomenon? Deleuze and Felix Guattari’s *rhizome* is a concept that appears compatible with such kind of thinking. John Landau articulates the rhizome concept clearly as follows:

Some plants do not singularly propagate from one root system, but multiply propagate from a rhizome network. ... A reed is one offshoot of an underground horizontal stem or rhizome which may connect with any other rhizome. To cut the reed does not kill the plant. ... Any of several reeds in the area may belong to the same rhizome without any apparent (surface) connections. They appear to be disparate, yet have hidden connections. Thus the rhizome becomes a metaphor for *disjunctive syntheses*, holding together what apparently cannot hold together.

... The message of the rhizome is crossfertilization to the nth degree, and the creation of hybrids. (Landau, 1997, p. 1)

In this chapter, I lay out a rhizomatic preface to the ethnography of mathematics classrooms with a particular focus on mathematics teacher culture. Section 1.1 serves as a preface to poststructural theorizing that takes as its case the nature of school mathematics. In particular, I ask: What is school mathematics about? In section 1.2, I briefly discuss the nature of “mathematics classrooms” from a poststructural perspective.

It is within this perspective that I formulate the research questions that I take to task in this dissertation. Section 1.3 provides a summary of significant ideas that are developed in this chapter and includes anticipatory remarks for the next chapter on the conceptual framework.
1.1 What is School Mathematics About? Some Preliminary (Foucauldian) Musings

What is the nature of school mathematics? How has school mathematics changed over the past centuries? Following Foucault’s problematizing of the history of biology in various epochs, we ask: is classical school mathematics the same as modern school mathematics? Is school mathematics a tool that is still nowadays useful in cultivating the self? Or has it become a modern tool, deployed\(^3\) by a disciplinary society that is obsessed with order and regularization?

I raise these questions to open the possibility of poststructural thought to a meditative thinking about the nature of school mathematics. This is an important section in this study mainly because ethnography and school mathematics have been viewed as two disciplines that come from two extreme poles: the former as a discipline in the arts and humanities and the latter as a discipline in the "hard" sciences. Since this study concerns the ethnography of school mathematics classrooms, we need to unpack the social dimension of change that has occurred in the nature of school mathematics. Perhaps by doing this, we may begin to clarify what it is in the ethnography of mathematics classrooms that we must seek to resolve, if only provisionally.

Some definitions are in order. An *episteme* is a Foucauldian term that, according to Martin Hauggaard, refers to:

the fundamental ordering code of a culture. It is not a spoken code, nor

---

\(^3\) Following David Shutkin, “deployment” is a Foucauldian term that carries with it relational forms of productive power: “power produces things, it induces pleasure, forms knowledge, produces discourse. It needs to be considered as a productive network which runs through the whole social body” (Foucault, 1982, p. 119; quoted in Shutkin, 1998, p. 206).
is it deliberately created by anyone. According to Foucault, it exists as a pure experience of order which is prior to the actual orders which individuals living in a given culture actually create discursively (Foucault, 1970, p. xxi). The episteme is the taken for granted reality which makes it possible for actors to express order in the world. (Haugaard, 1997, p. 51; emphasis added)

What is then produced from an episteme are not propositions but statements (Deleuze, 1988), whose meanings make sense within a context, that is, within a “given epistemic regime of truth” (Haugaard, 1997, p. 52; see also Hubert Dreyfus and Paul Rabinow, 1983, pp. 45-52). Statements are not only manifested linguistically, but “can include any form of representation of information” (Haugaard, 1997, p. 52).

So what is a regime of truth? Foucault defines it in the following way:

Each society has its regime of truth, its “general politics” of truth: that is, the types of discourse which it accepts and makes function as true; the mechanisms and instances which enable one to distinguish true and false statements, the means by which each is sanctioned; the techniques and procedures accorded value in the acquisition of truth; the status of those who are charged with saying what counts as true. (Foucault, 1980, p. 131)

The way we think about changes in mathematics can be seen as being related to the episteme of our time; we are inevitably linked to it and thus, we act within it. Mathematics, if we make use of Foucault’s views, is involved in truth production⁴ and in its own discourse formation. Mathematical truths, say, about the nature of mathematical objects or the concept of a mathematical proof, are all statements that are locally constituted within a regime of truth, that is, within a philosophical approach to

⁴ “Truth production” is a Foucauldian term that refers to the “common rules which determine the seriousness of statements - what qualifies as a statement and what does not” (Foucault, 1980, p. 131).
mathematics (Raymond Wilder, 1965). For instance, the regime of truth by realists takes it as given that mathematical objects exist and reside in the noosphere\(^1\) (i.e., world of ideas) independent of the human mind (Shlomo Vinner and David Tall, 1988, p. 352); the regime of truth of formalists denies the existence of mathematical objects and consider mathematics and mathematizing to be linguistic activities embedded within formal systems (Ibid.; see also Edwin Snapper, 1979, pp. 212-214). The logicists and the intuitionists also impose their own regimes of truth about objects and proofs.

The modern episteme, according to Foucault, is concerned with the order of things. Haugaard writes:

(M)an, who draws up the table and creates order, is a modern invention. This is what Foucault meant by asserting that "(b)efore the end of the eighteenth century man did not exist" (Foucault, 1970, p. 308).

... Kant is the key to the transition from the classical to the modern episteme. Kant argued that the order which we perceive in the world is a reflection of the human mind. For Kant, man is a finite creature who does not perceive of the world in pure form (what he called the noumenal world). Rather, man imposes order upon the world through \textit{a priori} concepts and creates for himself the phenomenal realm - the world of things as he sees them. \textit{A priori} concepts order reality by limiting it. (Haugaard, 1997, p. 63)

Rereading the history of foundations in mathematics, this insistence on order may have encouraged formalists, as well as logicists, to overcome the ontological problems of mathematical objects by insisting that mathematical truths must be demonstrated using finite sequences of axioms and rules of logic.

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\(^{1}\) "Noosphere" is a term coined by Teilhard de Chardin some time in the 1920s. See Guy Brousseau, 1997, p. 22.
And what is the *episteme* in the history of the present school mathematics, in the technological present we call the *postmodern*? Specifically, what regime of truth about the nature of school mathematics is being deployed by the *Curriculum and Evaluation Standards* (NCTM, 1989)⁶? Invoking the assumed needs of future workers -- that they be mathematically literate -- the *Standards* reasons as follows:

Today, economic survival and growth are dependent on new factories established to produce complex products and services with very short market cycles. ... Traditional notions of basic mathematical competence have been outstripped by ever-higher expectations of the skills and knowledge of workers; new methods of production demand a technologically competent workforce.

... Although mathematics is not taught in schools solely so students can get jobs, we are convinced that in-school experiences reflect to some extent those of today's workplace. (Standards, 1989, pp. 3-4)

Viewed from a Foucauldian perspective, the *Standards* exists as an instrument that is being deployed as a technology of regularization and normalization. Foucault, in *Discipline and Punish*, argues that the plague at the end of the seventeenth century organized the community through "strict spatial partitioning" (Foucault, 1977, p. 195): "it ensured that each individual was assigned to a place and fixed within it" (Foucault, 1977, p. 253). Further, it became possible to regulate and divide the healthy from the sick and the normal from the deviant. Once again, we are in the midst of a *restructuring* (= reform, our own "plague") in school mathematics. The *Standards* tend to operate within this perspective of "spatial partitioning:" there is an explicit divide,

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⁶ Here referred to as the *Standards* of the National Council of Teachers of Mathematics (NCTM, 1989).
curriculum-wise, between college-bound students and noncollege-bound students. (This practice is most felt in the school where this study takes place.) College-bound students get the "real stuff" of mathematical content while noncollege-bound students get the "bare minimum." Each student is subjected to a form of surveillance: the way they will tend to think of mathematics depends on how they have been individualized and subjectified by recommended and implemented social practices.

I close this section provisionally with some thoughts on mathematical myths, based on Paul Dowling's ethnographic and textual analyses of the nature of school mathematics in England. Meditatively thinking about the status of school mathematics, Dowling (1998) argues that "mathematics is a mythologizing activity to a degree that is probably unparalleled on the school curriculum" (p. 2). Dowling (1998) insists that (school) mathematics nowadays has been fetishized and has been invested with "mathematical use-values: not more mathematicians, but a more mathematically competent workforce and citizenry" (p. 3). Deploying mathematics in the modern school has propagated the following myths:

---

Social theorists, such as Michael Apple and William Tate, have raised cautionary remarks concerning this practice. See Apple, 1992 and Tate, 1996.

I use the term "fetishism" as it was originally defined by ethnographers of 18th-century primitive religions: "an inanimate object invested with magical powers" (Douglas Smith, 1996, p. 136). Karl Marx's fetishism of commodities deals with "how relations between commodities displace and obscure the social relations which enable their production" (Ibid.). By "use-value," I mean the Marxist term that "refers to the usefulness of the good for the consumer, its practical value or utility as a commodity" (Dominic Strinati, 1995, p. 57). "Exchange-value" is also a Marxist term that is a "social relational property of things" (Paul Cohen, 19xx, p. 115).
• *Myth of reference:* that mathematics is portrayed as "being, at least potentially, about something other than itself" (Dowling, 1998, p. 4);

• *Myth of participation:* that mathematics is "for something else. Mathematics justifies its existence in the school curriculum by virtue of its utility in optimizing the mundane activities of its students. ... It constructs mathematics, not as a system of exchange-values, but as a reservoir of use-values" (*Ibid.*, p. 9), and;

• *Myth of emancipation:* referring to ethnomathematics, mathematics is seen as "revealing the truly mathematical content of what might otherwise be regarded as primitive practices" that "elevates the practices and, ultimately, emancipates the practitioners" (*Ibid.*, p. 15).

1.2 "Mathematics Classrooms:" Bodies Without Organs

The ethnography of mathematics classrooms. This is what this work in its inceptive stage is about, or at least based on Paul Dowling’s perspectives about what constitutes the sociology of mathematics education. Beyond modernist naivété, "mathematics classrooms," herein viewed as a collective unitary concept but never singular, has been (re)invented, politicized, and anthropomorphized in this period of the

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9 I thank Suzanne Damarin for gently putting these words -- hers -- into my unconscious.

10 Hence the use of the neutral pronoun "it" in various places.

11 Following Deleuze and Guattari, by “singular” I mean each “mathematics classroom” has no stable identity, in fact, is a difference-in-itself (Landau, 1997; Susan Stodolsky, 1988). This has an important bearing on restructuring in education (Ann Lieberman, 1992, p. 2) because restructuring, viewed as a modernist problematic, presupposes a type of linear progression (totalization) applicable to every singular “mathematics classroom.”
contemporary we call the postmodern. It needed to be (re)invented because in the history of the present, it is slowly moving beyond its parochial signification as a merely geographical location; it is a field that, following Peter McLaren, is -- and always already -- a site of contestatory power, where "geo-political vectors of power crosscut the cultural terrain under investigation" (McLaren, 1992, p. 79).

It is politicized inasmuch as all "mathematics classrooms" are deterritorialized, in a Deleuze-and-Guattarian social theoretic sense: they are disconnected and yet reconnected (Paul Patton, 1996, p. 242; Stanley Aronowitz, 1992, pp. 255-256), functioning within the doppelganger of a "late capitalist" system in which central power is not total but disaggregated and diffused which implies that all classrooms are locally central(ized). In other words, "mathematics classrooms" exist in a deterritorialized space: each is invested with a local(ized) power that spawns its own truth production, its regime/s of truth, and its own becoming.

"Mathematics classrooms" is anthropomorphised; it subsumes a human form psychophysically and socioculturally because, axiomatically, the constituting elements are mathematics teachers and mathematics students. And yet, its most significant characteristic seems to lie in its becoming -- its nonidentity. By nonidentity here, it is useful to think of a Deleuzean schizophrenic: one with a "fractal mind" (Laundau, 1997) affirming its multiplicituous nature, and "explor(ing) and promot(ing) new forms of human action that acquire power and value by deliberately eluding identification and direct affiliation, by refusing totalizing, closed systems of thought" (Mary Leach, 1996, p. 4).
This ethnographic study focuses on teachers teaching in urban "mathematics classrooms." Admittedly, a significant number of students in these classrooms live in "hunger, poverty, and violence that trap so many [of them] in the ghetto of despair" (Sharon Robison, 1996, p. 379). Many studies in critical pedagogy and radical democracy are engaged in armchair emancipatory projects, "hero-izing" the urban student, and "oprah-izing" the sad realities she or he face daily in life. Critical pedagogues point to "timid supervisors, bigoted administrators, and ignorant school boards" (Thomas Romberg, 1988, p. 224) as unmotivating sources of ineffective teaching. Teachers themselves have had their share of severe criticisms from reformers (Larry Cuban, 1995, 1993, 1970; Kenneth Sirotnik, 1988, 1983; Donna Kerr, 1983). This study meditatively thinks about teachers' lives in urban mathematics classrooms, especially at this time when mathematics teachers are confronted with what is slowly emerging as the constructivist dogma in school math reform. I align with Alan Bishop in his insistence on the fact that "the teacher [i]s the key person in mathematics education, and research which ignore[s] this fact stands a good chance itself of being ignored" (Bishop quoted in Celia Hoyles, 1992, p. 32). Specifically, this study revolves around the lives of four secondary mathematics teachers in Copeland High School (CHS)\(^{12}\), an urban school located in a growing mid-Western state and with a student population of a little over 1000. In CHS, students are approximately 65% African Americans, 2% Asian-Americans, and the rest Caucasian-Americans. Two of the

\(^{12}\)Following ethical practices of anonymity and confidentiality, the real name of the school has been changed to Copeland High School. A psychoanalytic reading of myself reveals the word "Copeland" has much to say about my experiences with the teachers I worked with in this school.
teacher-participants are male: Mr. Jack is African-American and Mr. Taft a Caucasian-American. The two female teacher-participants, Ms. Prahst and Ms. Lynch, are Caucasian-Americans. Both Ms. Lynch and Mr. Jack have been with CHS for five years. Ms. Prahst has been with CHS four fourteen years and was chair of the mathematics department for five years. Mr. Taft has been with CHS for ten years and is the school’s current mathematics department chair.

Working within the *sutra* of a poststructural ethnography, this ten-week study on mathematics teachers is bifurcated into two constructs that emerged from the data I collected. In a most interesting way, the two constructs converge and respond to J. Shroyer’s question: “What makes teaching [mathematics] difficult?” (quoted in Hoyles, 1992, p. 32). The first construct deals with the *multiplex* question of specificity: *What does it mean to teach high school mathematics in an urban school at the present time?* The second construct is a question of subjectifying practices: *In what ways does mathematics teaching subjectify students into a way of thinking about/acting/doing mathematics?* These constructs are discussed in detail below.

### 1.2.1 Research Question 1: Specificity of Urban Mathematics Teachers’ Work

13 A detailed description of each teacher is provided in Appendix A. *The teachers are identified by pseudonyms.* The structure of the discussion for each case uses Paul Ernest’s (1989) Model of Mathematics Teachers’ Knowledge, Beliefs, and Attitudes.

14 This is explained in detail in Chapter Three.

15 Actually, these constructs initially took shape after I conducted a pilot study last Winter 1997. The pilot study involved one white American male mathematics teacher, also from Copeland High.

16 I use the term “multiplex” to mean “many complexes all folded together” (David Bohm, 1980, p. 166).
What does it mean to teach high school mathematics at the present time, in the Age of Constructivism where the “rule” is best summarized by the following statement: “all students must actively construct their mathematical knowledge?” How do mathematics teachers’ personal epistemologies, beliefs and attitudes, practices, and previous mathematical experiences or prior mathematical knowledges (i.e., the mathematical truths they learned as early as their own high school years) act on the way they teach mathematics in their classrooms? What kind of mathematizing do they practice?

In an interesting JRME research article, Jeff Gregg (1995) raises the question: “Why have traditional practices been so constant and durable?” Gregg argues that mathematics teachers’ coping with the “tensions and contradictions” of their own beliefs and practices about mathematics only sustain those traditional (and thus, implicitly erroneous) beliefs. This ethnographic study attempts to reread that research finding by revealing the dialectics of the social context in the teaching of secondary school mathematics. Since this study is situated in an urban setting, it makes clear sense to ask the question of social context, that is, to what extent do the social context of mathematics teachers’ work and certain conditions of existence affect the way they teach

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17 JRME: Journal for Research in Mathematics Education.

18 The word “these,” referring to traditional practices, has been deleted. By “traditional practices,” Gregg means “the beliefs and practices that characterize the traditional approach to school mathematics” (Gregg, 1995, p. 442).

19 I use “conditions of existence” the way Gary Wickham defines it, as follows:

It is a term which refers to the means by which the connections between an object -
Mathematics? More to the point, in what ways do they "impose limitations on classroom practices and curriculum innovation"?

1.2.2 Research Question 2: Mathematics Pedagogy as a Discursive Practice

"Everything is dangerous" writes Foucault (1984, p. 343). In mathematics pedagogy, for instance, teaching by "telling" has achieved a near deified status. The rule is simple: *Watch, listen, and do what the mathematics teacher says.* John Smith (1996) presents a somewhat different and yet interesting perspective to this instructional technique, which Guy Brousseau has referred to as the *Socratic maieutic*.

Smith argues that when mathematics teachers "state facts and demonstrate procedures to their students" in a "clear and accurate" way, that practice provides a foundation for teachers' sense of efficacy - the belief that they can affect student learning - because the direct demonstration of mathematics is taken to be necessary for student learning. (Smith, 1996, p. 387)

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20See Hoyles, 1992, p. 34.

21Brousseau defines the "Socratic maieutic" as a teaching technique in which mathematics teachers almost always ask, to use Hugh Mehan's terminology, "known information questions" (see Mehan, 1979, p. 285).

The teacher sets a problem which the student must solve. If the student answers, she thereby demonstrates that she knows; otherwise the need for knowledge becomes apparent, and that calls for information, for teaching. *A priori,* any method that allows the memorization of favourable associations is acceptable. (Brousseau, 1997, p. 29)

Mathematics teachers are involved in the propagation of an illusion of autonomy: "The *Socratic maieutic* limits these associations to ones which the student can make herself" (Ibid.).
While it makes sense to analyze teaching by telling within the context of self-efficacy, perhaps it also makes sense to consider the extent to which that practice, as well as other pedagogical practices, subjectifies students into a way of thinking about/acting/doing mathematics in the classrooms.

I raise this question of subjectifying practices in relation to John Goodlad's perception about most -- if not all -- American classrooms. Based on his classroom observations, he argues that there seems to be a pervading cultural internship called "emotional neutrality" in the classrooms whereunder students' "consciousness is constructed under the form of an imaginary subjection," whereon they are acculturated to a form of passivity that keeps them under control and, following Foucault, whose bodies are made "docile" that "may be subjected, used, transformed, and improved" (Foucault, 1977, p. 136). With this in mind, I meditatively think about some of these "hidden practices," such as how a mathematics teacher behaves in class, how s/he gives directions, and especially how she develops mathematical ideas. For each teacher-participant in this study, I raise the questions: In what way/s may their practices, as evidenced in recorded transcripts of student-teacher conversations and my

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22Sarup wrote these line in relation to the operating function of ideological state apparatuses. See Sarup, 1996, p. 54.

23I first learned of this idea from Ralph Fletcher, who wrote Walking Trees (1991), a most compelling autoethnographic account of his experiences (as a writing teacher trainor) with public school teachers and students in selected New York city schools.

24"Hidden" in the sense that the practices may be (partially) unknown to the teacher who deploys them.
own experiences as a participant-observer in her/his classes, affect the way students learn mathematics? In what way/s may these "practices" affect the evolution of mathematical ideas in the particular classroom?

1.3 Summary

Two personal thoughts forefathered this summary, my own Freirean “letter to those who dare teach” (Freire, 1998). Echoing those that are involved in empowerment pedagogy, we can always find inspiration from the neo-Marxist Paolo Freire, whose work has led to a radical rethinking of many “dreamy discourses” (Freire, 1998, p. 59) that have permeated educational theory (and theorizing) and practice in the past several years. Freire (1998) raises the following question: “(H)ow, from the theoretical context, do we “distance ourselves” from our practice and how do we become epistemologically curious in order to then understand our practice in its reason for being” (p. 77)?

First, this dissertation has been written with a postmodern agenda, or more explicitly, “to offer a sociology ... which is intended to bias” (Dowling, 1998, p. 2) and consequently, to motivate a rereading of the discourse of mathematics teaching that is imbricated within the problematic sphere of the social. This chapter is written as an exercise in meditative thinking about the ethnography of urban “mathematics classrooms.” Such thinking employs a rhizomatic perspective. My interest, early at this stage, is to encourage readers to (w)rest(le) comfortably within an ethnographic discourse
of teaching secondary school mathematics in an urban setting. Perhaps in acknowledging this schizophrenia we fulfill the Freirean condition of distancing ourselves.

In section 1.1, I claim that we live and act within the episteme of our time. School mathematics does not appear static to me, at least not at the meta-level. I hope I do not belabor the point by digressing into the history of mathematics to prove my point. In Donald Gillies' edited book, *Revolutions in Mathematics*, philosopher of mathematics Caroline Dunmore (1995) insists that mathematical revolutions do not occur at the object-level of the "concepts, terminology and notation, definitions, axioms, and theorems, methods of proof and problem-solutions, and problems and conjectures" (p. 211). Rather they occur at the meta-level, that is, the "metamathematical values of the community that define the telos and methods of the subject, and encapsulate general beliefs about its nature" (Ibid.). It is the metamathematical values (or Foucault's episteme), and not the objects and results, that are "discarded and replaced" (Ibid.). Proofs of this kind of revolution are found in the histories of non-Euclidean geometries, incommensurable line segments, and negative and imaginary numbers.

In the case of school mathematics, these meta-level revolutions can be found if one does a critical rereading of the symbolic and historical significance of "the Sputnik" in various decades of the twentieth century. Further, I argue that the *Standards* operates as a technology of regularization and normalization and in a way that spatially partitions college-bound students and noncollege-bound students. I close section 1.1 with a note from Dowling. Dowling's epistemological curiosity about the nature of school mathematics (in England) has led to a sociotextual rereading in which school
mathematics is perceived as a mythologizing activity, deploying myths of reference, of participation, and of empowerment. That, to me, exemplifies the quintessential type of poststructural theorizing in mathematics education which this ethnographic study attempts to follow.

Second, I need to address a specific (already anticipated) concern that readers who will care to read this dissertation may have. Catherine Bell (1992) articulates this concern very well: “Many attempts to produce a paradigm shift end up simply repackaging old problems in new jargon” (p. 7). Before I respond to that concern, allow me to summarize what section 1.2 is all about. The first part consists of a brief discussion about the nature of “mathematics classrooms,” as a reinvented concept, politicized, and anthropomorphized in the postmodern. The second part extrapolates two research questions that motivate this ethnographic study. They are as follows:

1. What does it mean to teach high school mathematics in an urban setting at the present time? Specifically: How do mathematics teachers' personal epistemologies, practices, beliefs, attitudes, and previous mathematical experiences or prior mathematical knowledges act on the way they teach mathematics in the classrooms? What kind of mathematizing do they practice? In what ways do the social context of mathematics teaching and certain conditions of existence impose their limitations on classroom practices and curriculum innovation?

2. To what extent do pedagogical practices subjectify students into a way of thinking about/acting/doing mathematics in the classrooms?
Specifically: In what way/s might these practices affect the way students learn mathematics? In what way/s might these practices affect the evolution of mathematical ideas in the classroom?

From the data he obtained in 1983 from at least 1000 elementary and secondary schools, Sirotnik has shown that there is little change in teaching practices across schools. His findings reveal that, “over the course of the century,” the “modus operandi” of the typical classroom is still didactics, practice, and little else” (Sirotnik, 1983, p. 16). In 1988, Sirotnik suggested that classroom researchers engage in a type of critical inquiry that is rigorous, time-consuming, collaborative, informed, school-based dialectic around generic questions such as: What is going on in the name of X? ... How did it come to be that way? Whose interests are being (and are not being) served by the way things are? What information and knowledge do we have - and need to get - that bear upon the issues? ... Is this the way we want it? What are we going to do about all this? (Get on with it.). (Sirotnik, 1988, p. 64)

This ethnographic study commingles with Sirotnik’s critical inquiry perspective, but not fully. The use of poststructural ideas such as subjectification and the rhizome both open and deepen the politics of possibility through a careful analysis of the structure of complexity of the social phenomena that is prevalent in urban “mathematics classrooms.”

What, then, do I hope to accomplish in this work? This dissertation attempts to provide a textual intervention -- through a politics of disclosure -- to issues raised in teacher culture and urban schooling. With this work, I hope to make some significant contribution to current postmodern ergonomics of mathematics teacher reform through a
laying out the structure of complexity of urban teachers' situational realities. In addition, this work provides an initial framework for understanding mathematics teaching and pedagogy as tools of social regulation and subjectification, that is, exercising a power to construct a student's math subjectivity. Insofar as the study succeeds, Bell's concern is important, but not really all that significant.

In Chapter Two, a detailed four-part conceptual framework is presented. It employs a rhizomatic pragmatic as a theoretical backcloth to an understanding of urban mathematics teachers' work, culture, and pedagogical practices is presented.

In Chapter Three, I give a personal account of my ethnographic experience. I also explain how and what I mean by methodology, and I engage in validity talk. In Appendix A, I present data I obtained from my participants through observations, interviews, documents, and survey/grounded survey questionnaires.

In Chapters Four and Five, I present two different but interconnected analyses of mathematics teacher culture and pedagogy. Chapter Four is a rereading of my teacher-participants' culture: the significance of the social context, the gendered nature of mathematics teaching, the role of beliefs, and so on. Chapter Five outlines a framework for understanding secondary mathematics teaching from a Foucauldian perspective.

Chapter Six is a provisional closure. In this chapter, I provide a comprehensive summary of the first five chapters and carefully highlight the intertextual significance of concepts found between and across chapters.
CHAPTER 2

URBAN MATHEMATICS TEACHERS’ WORK, CULTURE, AND PEDAGOGICAL PRACTICES AS LINES AND FOLDS: A RHIZOMATIC (CONCEPTUAL) FRAMEWORK

We incomprehensible ones.
Friedrich Nietzsche
The Gay Science

Researchers in mathematics education should never become wedded to a single approach, epistemology, paradigm, means of representation, or method. All are partial and provision; none can tell the whole story. ... (T)he field as a whole needs to encourage multiple methods.
Jeremy Kilpatrick
Staking Claims

Introduction

The Deleuzean rhizomatic: a multiplex network of forces, “distributions, referrals, (and) spaces” (Jean-Luc Nancy, 1996, p. 108) that maps (and not merely traces) a facture that enables “multiple entryways” (Gilles Deleuze and Felix Guattari, 1987, p. 14). Deleuze and Guattari distinguish “mapping” from “tracing,” and insist rhizomes map more than trace. They write:

The rhizome pertains to a map that must be produced, constructed, a map that is always detachable, connectable, reversible, modifiable, and has
multiple entryways and exits and its own lines of flight. It is tracings that must be put on the map, not the opposite. (Deleuze and Guattari, 1987, p. 21)

“Lines of flight,” according to Todd May,

break both the axioms and the codes of a given society in order to create new forms of life that are subversive to the repressions of that society. They do not flow along regulated pathways, but are instead "transversals" to them, cutting across them and using elements from them in the process of doing something new, different, and most important, alive. (May, 1991, p. 32)

The rhizome foregrounds *transiextuality*¹ and the paratactical play of ideas, and engages -- almost always transgressively -- in a plurality of meaning making that defies the “binary logic of dichotomy” (Deleuze and Guattari, 1987, p. 5). Zygmunt Bauman (1992) writes of the rhizome as “possessing no sense of privileged direction, expanding instead sideways, upwards and backwards with the same frequency and without detectible regularity which would enable a prediction of the next move” (p. 27).

“To function rhizomatically,” according to Patti Lather, is one way “(to) open up thought to creative constructions” (Lather, 1993, p. 680) that are invested with future emancipatory possibilities. This chapter develops a conceptual framework that employs a rhizome as a theoretical backdrop to an understanding of urban mathematics teachers’ work, culture, and pedagogical practices. Section 2.1 is about Michel Foucault’s concept of power-knowledge and, especially, the decentering of *ideology* in work on power relations. As usual, and to borrow Eric Hobsbawm’s (1992) words, we have "a crisis in

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¹ Gerard Genette: “all that which puts one text in relation, whether manifest or secret, with other texts” (quoted in Robert Stam, Robert Burgoyne and Sandy Lewis, 1992, p. 206). “Intertextuality” (restricted to two texts) is subsumed in transtextuality.
today's ideologies" (p. 55). Mathematics teachers, whose lives and work (environment) are caught up in the externalities of schooling, find themselves confronted with various discursive and nondiscursive practices which may not be mapped consequentially to particular ideologies but which are more realistically effects of power-knowledge relations. This section is necessary because it explains the "Foucauldian shift" to discourse and thus, making it possible to define the work of genealogy in the context of non/discursive formations. It is useful to mention at this stage that this study is about everyday acts of mathematics teaching in an urban school in which the acts, ironically, are spreading rhizomatically within/against "competing discourses." The study also foregrounds the resistance that many mathematics teachers are according current (calls for) reforms in mathematics education.

Section 2.2 briefly outlines the methodological analytic of a Foucauldian genealogy. Section 2.3 focuses on techniques of subjectification. I appropriate Jennifer Gore's model of power relations in pedagogy, a model that is based on her readings of Foucauldian texts and which she employs in several of her research studies on disciplining bodies and regimes of pedagogy.

Section 2.4 is about notions of a teacher's knowledge, beliefs, and attitudes. In section 2.5, I present a nonexhaustive set of research findings obtained from sociological studies on teacher culture, especially those that deal with the conditions of existence that affect teachers' work environments. In particular, I use Judyth Sachs and Richard Smith's

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2 Gore (1998): A "regime of pedagogy" consists of "power-knowledge relations, of discourses and practices which constrain the most radical of educational agendas" (p. 232).
model of teacher culture. Section 2.6 provides a summary of important ideas raised in the chapter. Here I explain the significance of Deleuzean lines as they relate to my use of the rhizome.

2.1 Framing a Discourse on Pedagogy:

Immolating Ideology and Problematizing Truth

Foucault insists that we live and act within the *episteme* of our time. Moreover, Foucault (1980) insists that there are only interpreted truths, that is, truths-from-a-perspective. "Truth is a thing of this world: it is produced only by virtue of multiple forms of constraint. And it induces regular effects of power" (p. 131). Indeed, what counts as a true (or false) statement depends on the regime of truth it subscribes to (Bob Carter, 1997, p. 129). This is what Foucault (1980) means when he argues that truth, as a form of power, "is linked in circular relation with systems of power which produce and sustain it, and to effects of power which it induces and which extend it" (p. 133).

There can never be truths in a totalizing (teleological) sense and nor can truths be simply claimed by a privileged Others or rooted in some particular ideology, that is, subject-oriented, at least the way (traditional) Marxists have led us to believe. The *in*  

3 *A regime of truth* is a disembodied unit from an episteme, and it need not be viewed negatively all the time. It can be repressive (e.g., certain neoliberal schooling practices), but it can also be transgressive, that is, productive. For instance, a mathematics teacher’s regime of truth operates negatively if the process of deploying the regime of truth induces her/his students to accept her/his own version of “knowing about the world” and “violently” excludes the multiplicitous nature of mathematical knowing. A positive (productive) regime of truth is exemplified in a mathematics teacher that espouses *devolution* and dialogue.

4 The statement in italics foreground the undecidability, and not the indeterminacy, of judgment.
extremis status of ideology in much of Foucault's work is central to our understanding of the "Foucauldian shift" that this study claims to make. Ideology, at least as I take it, is not simply "belief systems" nor "lived relations." Such depoliticized conceptions trivialize the impact of ideology on intersubjective formation. To belief systems and lived relations we must adjoin the idea of mythification, thereby constituting an individual and/or a collective un/consciousness to certain ways of thinking that reproduce the social order. The Marxist concept of ideology, for instance, is tied to the repressive act of domination -- a kind of “negative mystification.”

Foucault argues that:

The notion of ideology appears to me to be difficult to make use of .... I believe the problem does not consist in drawing the line between that in a discourse which falls under some category, but in seeing historically how effects of truth are produced within discourses which in themselves are neither true nor false” (Foucault, 1980, p. 118, italics mine).

Thus, the problem is not one of ideology but of the role of discourse -- its effects and the deployment of various discursive formations -- from which knowledge, power, and power relations are “tri-axially” interacting, and thus mutually constituting our social reality (Martin Haugaard, 1997, p. 43) in which we locate our subject essence⁵, our being-ness in this world⁶.

² The phrase “subject essence” may appear as an oxymoron considering the anti-essentialist tone of most of Foucault’s work which seems to strongly suggest the contingency of our being. But a moment’s reflection raises the question of the purpose of the need to transform into something better than how and what we are at this moment, strategically "to refuse who we are," writes Foucault, in order to develop appropriate technologies of the self.

⁶ I find it interesting to see Michael Apple’s evolving conceptions about ideology and postmodernism in education, that is, from his engaging extrapolation of the role of hegemony in educational discourse (see Ideology and Curriculum) to a close attentive reading of postmodern approaches (see Cultural Politics and Education and especially Education and Power wherein he
Foucault (1980) outlines the following characteristics of power (pp. 92-108):

- Power is sited in extreme situations.
- Power that produces bodily effects must be a main concern.
- Power operates through technologies of normalization and technologies of self.
- Power is never possessed; it circulates, is deployed, and is exercised "through a net-like organization" (*Ibid.*).
- Power has both repressive and productive natures and effects.
- Power is "both much more and much less than an ideology. It is the production of effective instruments for the formation and accumulation of knowledge -- methods of observation, techniques of registration, procedures for investigation and research, apparatuses of control" (*Ibid.*, p. 102).

In this section, I am concerned with power relations, specifically pedagogical power relations, which for Foucault, "do(es) not inherently include domination" (Kevin Heller, 1996, p. 103). Foucault argues as follows:

I don't see where evil is in the practice of someone who, in a given game of truth, knowing more than another, tells him what he must do, teaches him, transmits knowledge to him, communicates skills to him. The problem is rather to know how you are to avoid in these practices ... the effects of domination which will make a child subject to the arbitrary and useless authority of a teacher. (Foucault, 1988, p. 18; emphasis)

rereads social and cultural reproduction theories as providing totalizing, reductionist perspectives and thus, failing to explain inherent contradictions. Although I must insist that postmodern educators are not engaged in a project of "substituting one grand narrative for another" (Apple, 1996, p. xii) but in widening the conditions of possibility, in carefully understanding the "microphysics of power" that determine our subject essence, in exploring the full implications of the poststructural space of undecidability that we educators always already find ourselves working within/against, and in developing becoming-spaces for counterhegemonic discourses (= resistance discourses) in the postmodern moment.
So how do we characterize power relations? Power relations, according to Foucault, are "both intentional and non-subjective" (Foucault, 1990, pp. 94-95): intentional because all individuals exercise power; non-subjective because the mechanisms of power, which Deleuze (1988) calls the diagram (p. 28), are supra-individual -- "they do not depend on the existence of those individuals for their own existence" (Heller, 1996, p. 85). In a simple way, we can view the non-subjective nature of power relations -- the diagram -- as being related to the "inevitable disjunction" between intention and effect (= unintended result of action). As Heller (1996) insists: "(N)ot all institutional transformations are intentionally produced; some transformations are unintentionally (non-consciously) produced" (p. 87). Heller thus distinguishes between tactics and strategies:

"Tactics" are the intentional actions carried out in determinate political contexts by individuals and groups; "strategies" are the unintentional - but institutionally and socially regularized - effects produced by the non-subjective articulation of different individual and group tactics. (Heller, 1996, pp. 87-88)

Heller illustrates the disjunction by rereading Foucault's history of the modern prison: while the tactic is indeed to rehabilitate the prisoner, the strategy -- the unintentional effect -- is far from that; it is to punish the prisoner.

7 According to Foucault (1980): "(O)ne doesn't have here a power which is wholly in the hands of one person who can exercise it alone and totally over the others. ... everyone is a caught" (p. 156).
Power relations presuppose that some individuals are capable of manipulating the *diagram* (and thus, domination occurs), but this does not imply absolute control. This then leads to the notion of subjectification and subject positions. The construction of subject positions, following Foucault, involves various multiplicities and contradictions that are not easily reduced to a *single will*. Foucault states:

> We should try to discover how it is that subjects are gradually, progressively, really, and materially constituted through a multiplicity of organisms, forces, energies, materials, desires, thoughts, etc.... This would be the exact opposite... of all jurists for whom the problem is the distillation of a single will ... from the particular wills of a multiplicity of individuals. (Foucault, 1980, p. 71)

Thus a discourse, *unlike* ideology, is not to be viewed in general terms and as always already producing hegemonic subject positions, but as "historically-specific *discourses* - discourses that produce both hegemonic and counter-hegemonic subject positions" (Heller, 1996, p. 94). Heller (1996) illustrates this point by, again, rereading the discourses on justice (in *Discipline and Punish*) and homosexuality (in *History of Sexuality, Volume One*) (pp. 94-98).

### 2.2 Foucauldian Genealogy

Discursive notions such as regimes of truth and other politico-analytical discourses that deal with "instances of discursive control" (Foucault, 1980, p. 71) are embedded within larger, and more extensive, Foucauldian methodological projects of interpretation. Most of Foucault's work deals with *archaeology* and *genealogy*, two important epistemological tools for analyzing taken-for-granted realities in our society. *Archaeology* is his earlier method of interpretation which he employed when he dealt with
historical systems of institutional and discursive practices (such as the histories of madness and the asylum). As a quasi-structural conception, archaeology is a “task that consists of not - of no longer - treating discourses as groups of signs (signifying elements referring to contents or representations) but as practices that systematically form the objects of which they speak” (Hazard Adams and Leroy Searle, 1986, p. 137, italics mine). Further, it is a “history of thought centered not in the individual subject but in the linguistic structures defining the fields in which individual subjects operate” (Gary Gutting, 1994, p. 14). Archaeology, then, involves decentering the Subject of discourse and the centering of the Discourse of subject.

A Foucauldian genealogy, as exemplified in Discipline and Punish and the History of Sexuality (Volumes One and Two), explicates the nature and evolution of modern practices of power (Nancy Fraser, 1989). It analyzes cultural practices not in terms of semiological and structural systems of signs but in terms of systems and forms of power through discursive regimes and discursive formations. In a questioning mode, a genealogy asks: How are discursive formations shaped, and how does power act as a transforming difference in those formations? More than the decorticating of norms (i.e., the all too often taken-for-granted criteria of differentiation) and the power of the norms to objectify, how are individuals distributed around a norm? For instance, what is the

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8 Sarup: “By ‘decent[e]ring,’ I mean that individual consciousness can no longer be seen as the origin of meaning, knowledge and action” (1996, p. 46).

9 “Discursive regimes” are “processes, procedures, and apparatuses whereby truth and knowledge are produced.” “Discursive formations” are “linguistic practices and institutions that produce the knowledge claims, usually correlatable with a disseminated power, within which we exist socially” (Stam, Burgoyne, and Flitterman-Lewis, 1992, p. 211.)
economics of social distribution in an urban mathematics classroom? What dividing practices (Foucault, 1982, p. 777) do mathematics teachers employ in subjectifying their students to certain ways of thinking about, knowing and doing mathematics?

A Foucauldian genealogy begins with the premise that “something is terribly wrong in the present” (Gutting, 1994, p. 10). It is contrasted with traditional genealogy which focuses on a search for origins. As a Nietzschean method, a Foucauldian genealogy is a search for descent: “Searching for descent is the opposite of erecting foundations; it is to disturb the immobile, fragment the unified and show the heterogeneity of what was thought to be consistent” (Sarup, 1996, p. 72). Such a search implies the unpacking of technologies of normalization “whereby, on the basis of the descriptions of the local discursivities, the subjected knowledges which are released will be brought into play” (Ann Stoler, 1996, p. 60).

A traditional genealogy is embedded within a metanarrative discourse that advocates presentism: the inevitability of a present event as resulting from a past event. Moreover, it is oriented to continuities. As a “history of the present” (Foucault, 1977, p. 31), a Foucauldian genealogy is oriented to discontinuities (Fraser, 1989, p. 19); it is disordering the organization of a discipline (Andrew Lloyd and Dan Thacker, 1997); it focuses on “local, discontinuous, disqualified, illegitimate knowledges” (Foucault, 1980, p. 83); and it “undermines grand narratives of inevitable progress by tracing the origins of practices and institutions from a congeries of contingent ‘petty causes’” (Gutting, 1994, p. 14). Why the insistence on discontinuities? What is the nature of those knowledges that seems to validate the discontinuous character of a Foucauldian genealogy? Fraser
and Haugaard both argue that the changes that occur in various epochal moments in history often lead to a Kuhnian (succession of a) “plurality of incommensurable discursive regimes” (Fraser, 1989, p. 20), in which each regime has its own matrix of power, its own set of criteria for determining what is true and what is not, its own data-producing mechanisms, and its own “institutional sanctions and matrices” (Ibid.).

So if a Foucauldian genealogy seeks to foreground the immanence of discursive regimes, how is one’s “subject-ivity" situated within the genealogy? According to Foucault:

Genealogy does not abandon the subject, but examines it as a function of discourse, asking “under what conditions and through what forms can an entity like the subject appear in the order of discourse; what position does it occupy; what functions does it exhibit; and what rules does it follow in each type of discourse.” (Foucault quoted in Susan Chase, n.d., p. 3)

Further, it is through this genealogical scrutiny that s/he may come to know how s/he is constituted, but more importantly, how s/he must “resist a process of self-subjectification - ‘the manner in which the human being turns him(/her)self into a subject’ (Foucault, 1982, p. 778) - and individualization” (Haugaard, 1997, p. 43), that is, how s/he ought to reconstitute her/his own subjectivity in a process of self-transformation.

\[1^{0}\]Sarup distinguishes the self from the subject: “The ‘self’ is a neutral term, almost synonymous for individual. ‘Subject’ seems to be an active, historical term that refers to the process of interiorisation. The subject takes shape through historically experienced discourses - practices. ... the subject is both decent[e]red and relativist” (1996, p. 84). (The notion of “subjectivity” is extrapolated in detail in the aside of Chapter Five.

31
2.3 Techniques of Subject(ificat)ion: Gore’s Model of Power Relations

Work in the politics of education needs to situate its organon within a “postliberatory” perspective; that is, determine “how to take an oppositional relation to power that is, admittedly, implicated in the very power one opposes” (Butler, 1997, p. 17). Consider, especially, subjectification as a form of power. How do we “oppose” it while at the same time acknowledging the fact that our subject essence is deeply “attached” to it?

Butler, following Foucault, defines subjectification as a dyadic process of “subordination and forming of the subject” (Butler, 1997, p. 7). Most of Foucault’s work has focused more on subordination and its effects and less on subject formation, that is, the “specific mechanisms of how the subject is formed in submission” (Ibid., p. 2). In this section, we take the task of extrapolating techniques of subjectifying practices that are particularly relevant in the classroom context.

Table 2.1 provides a summary of techniques of subjectification based on Gore’s model of power relations in pedagogy (see Gore, 1998, pp. 234-245; 1995, p. 103). The model is based on Gore’s attentive reading of Foucault’s texts (especially Discipline and Punish) which she employs in several of her research studies on disciplining bodies and regimes of pedagogy. A brief explanatory unpacking follows.

Foucault (1988) argues that “(a) relation of surveillance, defined and regulated, is inscribed at the heart of the practice of teaching, not as an additional or adjacent part, but as a mechanism that is inherent to it and which increases its efficiency” (p. 18). Gore
illustrates the technique of surveillance in situations where students are engaged in “on-task” activities.

As for normalization, Gore cites Foucault in insisting that the technique involves comparing a subject to a “whole” and thus, produces a “space of difference” and “principle of a rule” that needs to be followed.” The Foucauldian whole within an educational context corresponds to “standards” in schools and pedagogy: “educating is

<table>
<thead>
<tr>
<th>Technique</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveillance</td>
<td>Supervising, closely observing, watching, threatening to watch, avoiding being watched, expecting to be watched</td>
</tr>
<tr>
<td>Normalization</td>
<td>Invoking, requiring, setting or conforming to a standard, defining the normal</td>
</tr>
<tr>
<td>Exclusion</td>
<td>Tracing the limits that will define difference, boundary, zone, defining the pathological</td>
</tr>
<tr>
<td>Distribution</td>
<td>Dividing into parts, arranging, ranking bodies in space</td>
</tr>
<tr>
<td>Classification</td>
<td>Differentiating individuals and/or groups from one another</td>
</tr>
<tr>
<td>Individualization</td>
<td>Giving individual character to, specifying an individual</td>
</tr>
<tr>
<td>Totalization</td>
<td>Giving collective character to, specifying a collectivity/total, will to conform</td>
</tr>
<tr>
<td>Regulation</td>
<td>Controlling by rule, subject to restrictions; adapt to requirements; act of invoking a rule, including sanction, reward, punishment</td>
</tr>
</tbody>
</table>

Table 2.1 Gore’s Model of Techniques of Subjectification
about the teaching of norms - norms of behavior, of attitudes, of knowledge” (Gore, 1998, p. 237).

_Exclusion_ takes the pathological path of normalization, Gore argues. The exclusion technique is about identifying “unspoken” lines of division, those “limiting lines” that privilege binary thought as it is defined within modern practices of pedagogy. Gore illustrates this edge of differentiation with a study done by D. Tyler in 1993. Tyler argues that “even in kindergarten, some children, some dispositions and behaviors, are constructed as ‘better,’ while others quickly are excluded” (Gore, 1998, p. 238).

_Distribution_ practices in pedagogy include “physically moving bodies, requiring students to form groups, to students moving themselves or imploring others to do so” (Gore, 1998, p. 241). Distribution induces a strict spatial partitioning -- fixing, ranking and/or isolating subjects in their respective location and situatedness.

_Classification_ practices express a desire for ideological differentiation, imposing taken-for-granted modes of characterization on individuals and situations. For instance, urban schools are engaged in tracking and other sorting technologies. Social and cultural reproduction theorists (see, for e.g.: Jean Anyon (1982); Pierre Bourdieu and Jean Claude Passeron (1985)) claim that certain practices of classification are motivated by the capitalist ideology. The subject of mathematics is deployed in some schools as a convenient ideological filter (see, for e.g.: Sue Johnston (1991)). Concerning issues that deal with gender and mathematics, feminists (e.g., Suzanne Damarin (1995)) claim the “implicit” functioning of the “male gene” in the deployment of mathematics in the
schools which systematically differentiates girls from boys in terms of their capability in doing serious mathematics.

*Individualization* and *totalization* are pedagogical practices that attempt to characterize individuals and groups, respectively. *Regulation* specifically focuses on explicit rules and norms that are imposed on situations and events.

### 2.4 Mathematics Teachers' Epistemologies, Beliefs, and Practices: More Conceptual Models

**Teachers' Epistemologies.** Robert Young (1981) argues that a teacher's epistemology or conception of knowledge influences how ideas are developed and deployed in classrooms (i.e., the instructional methods and the type of inquiry that are employed) and how *curriculum codes* are constructed, especially. The science teachers in Young's study\(^{11}\), for instance, subscribe to the Cartesian paradigm of certainty and hence exhibit a logical-empiricist view of knowledge. The model of inquiry they employ in their classrooms typically includes the following: theories are perceived as naturalized facts, and claims are proved on the basis of the falsifiability criterion and sensory and empirical observations. Young's English teachers, on the other hand, subscribe to a conception of knowledge that is "a collective product of a history of inquiry (Young, 1992, p. 19). They (especially those having a background in critical theory) tend to model a hermeneutic form of inquiry in which they empower their students to make meaningful, personal discoveries and to construct their own understanding and interpretations. They emphasize a “sharing of experience” (*Ibid.*); the pedagogical model

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\(^{11}\)Young claims his study has been replicated several times.
of inquiry employs "directed discussion and the study of model interpretations (e.g. teachers' or critics' interpretations)" (Ibid.), as well as occasions for both explicit transmission of facts and open ended dialogues.

A curriculum code is a form of knowledge that mirrors or draws its roots from "societally dominant epistemologies" which, when translated in the curriculum, is (mythically) valued and taken as institutionalized knowledge. There, too, are modal knowledges that are justified via utilitarianism and thus, are also classified as institutionalized knowledges. Consider again the subject of school mathematics. The general society has come to accept that the knowledges we obtain from mathematics provide an important function in the development of technological and scientific competence (Curriculum and Evaluation Standards, 1989). This utilitarian view has both positive and negative implications on how mathematical knowledge is coded in the curriculum. Sue Johnston's (1994) work on girls and school mathematics has shown that girls' (in)ability to do mathematics translates into a type of knowledge "filter:" mathematics is encoded and "recognized as a filter which is used to select people for future pathways" (p. 243).

Elizabeth Fennema and Megan Franke (1992) advance a mathematics teacher's knowledge model (see Figure 2.1) that "occurs in the context of the classroom" (p. 162) and is used in this study. The basic components include a teacher's knowledge of: (1) mathematics (content), (2) pedagogical knowledge, and; (3) knowledge of learners' cognitions in mathematics. The content of mathematics includes a teacher's knowledge of
Figure 2.1 Fennema and Franke's Model of a Mathematics Teacher's Knowledge
the triad of "problem solving, concepts and procedures" and the relations across, between, and within the triad. Content also involves a teacher's knowledge of (the interrelatedness of) mathematical ideas at macro-structural levels. *Pedagogical knowledge* includes a teacher's knowledge of "teaching procedures such as effective strategies for planning, classroom routines, behavior management techniques, classroom organizational procedures, and motivational techniques" (Fennema and Franke, 1992, p. 162). *Learning cognitions* are concerned especially with how students learn mathematics. The *context specific knowledge* refers to the specificity, situatedness, and context of a mathematics teacher's belief and knowledge. Context defines how knowledge and beliefs interact. More importantly, context indicates that (some of) the components of a mathematics teacher's knowledge "evolve through teaching\(^{12}\)" (*Ibid.*).

**Teachers' Beliefs\(^{13}\).** Young (1981) and Fennema and Franke (1992) assert that a teacher's epistemology -- which undergoes changes due to evolving contexts -- has an impact on the teaching and learning of school mathematics. A similar assertion can be made about teachers' beliefs. Alba Thompson (1992, 1984), along with Celia Hoyles (1992), Paul Ernest (1991), Thomas Cooney (1985), and most recently, Anne Raymond (1997), claim that a teacher's belief system has an impact on both her/his instructional practice and conception of mathematics teaching and learning.

\(^{12}\)The claim of evolution is supported by research results of Lee Shulman (1987) and R. Orton (1989), among others.

\(^{13}\)For a more detailed discussion which includes a review of mathematics education research on beliefs, see Thompson, 1992, pp. 127-146. Some of those ideas are discussed in Chapter Six here.
Thompson (1992) distinguishes between the concepts beliefs and knowledge. First, beliefs are held "with varying degrees of conviction" (p. 129) which are "absent from knowledge systems. One would not say that one knew a fact strongly" (R. Abelson (1979, p. 360) quoted in Thompson, 1992, p. 129). Second, beliefs are not consensual. Each person has her or his own belief system, and such a system need not satisfy some "external" truth conditions but is subject to dispute. Third, while the production and validity of knowledge adheres to some known and generally agreed upon criteria, that is not the case with beliefs; that is,

belief systems often include affective feelings and evaluations, vivid memories of personal experiences, and assumptions about the existence of entities and alternative worlds, all of which are simply not open to outside evaluation or critical examination in the same sense that the components of knowledge systems are. (J. Nespor (1987, p. 321) quoted in Thompson, 1992, p. 130)

Thompson (1992) insists, however, that knowledge undergoes revision over time, that is, old ideas and theories are subject to replacement as a result of paradigmatic changes and/or in light of new evidence that warrants the changes. Thus, the divide between knowledge and beliefs is problematic and oftentimes slippery because of the "temporal quality of theories as canons of evidence" (p. 130).

A belief system, writes Thompson, may be viewed as "a metaphor for examining and describing how an individual's beliefs are organized" (Thompson, 1992, p. 130). It is a dynamic, protean system because individuals undergo experiences which may have an impact on their beliefs. Drawing on T. Green's work on belief systems, Thompson (1992) asserts that within the elements in a belief system, there are primary and derivative
beliefs. For instance, if a mathematics teacher believes that mathematics is an objective science, then a derivative belief may be that there is only one method of solution to a given problem. Also, in terms of degrees of conviction, there are central and peripheral beliefs, with central beliefs being the strongest and peripheral beliefs the weakest and predisposed to changes. Thompson (1992) claims that it is possible to have a derivative belief that is central, or a primary belief that is peripheral (other combinations are possible). Finally, beliefs systems are usually held in clusters. The clustering "prevents crossfertilization among clusters of beliefs or confrontations between them, and makes it possible to hold conflicting sets of beliefs" (Ibid.). Thompson (1992) asserts that the clustering may explain the inconsistencies between teachers' beliefs and beliefs-in-practice.

**Teachers' Practices.** In this dissertation, when we study teachers' practices, we mean the "study of all forms of human action" (Sherry Ortner, 1994, p. 393). Theorizing practice involves understanding what motivates individuals to act. In anthropology, two perspectives have been raised: the theory of interest and strain theory. The theory of interest, the dominant perspective, posits active, "essentially individualistic" actors who rationally go after what they want, and what they want is what is materially and politically useful for them within the context of their cultural and historical situations. (Ortner, 1994, pp. 394-395)

*Strain theory*, on the other hand, assumes actors that are already predisposed to problem solving as a result of being wed to the structure of complexity of their situations.

The strain perspective places greater emphasis on the analysis of the system itself, the forces in play upon actors, as a way of understanding where actors, as we say, are coming from. In particular, a system is
analyzed with the aim of revealing the sorts of binds it creates for actors, the sorts of burdens it places upon them, and so on. (Ortner, 1994, pp. 395-396)

Strain theory, then, reveals the context of an individual's actions, as well the "social forces" that shape her/his motives (Ibid.).

Most (if not, all) mathematics education research on teachers' practices seem to be guided by interest theory. Motivated by constructivism, for instance, mathematics teachers tend to model actions and employ activities that "encourage or facilitate learner construction of knowledge" (Koehler and Grouws, 1992, p. 123). The project Cognitively Guided Instruction (CGI), as an exemplar, links "new knowledge to [a learner's] existing knowledge" and teachers "provide instruction appropriate for each student" (Ibid.).

Research studies that utilize an expert-novice paradigm to examine teacher development are based on an interest in improving teaching performance. Researchers, in particular, are interested in understanding the developmental transformation from novice to expert teaching, mainly for the benefit of novice teachers. Mathematics teachers who believe in the epistemological view that "students will only come to know mathematics if they learn mathematics in the way it is developed in the discipline" (Koehler and Grouws, 1992, p. 123) tend to practice problem posing and engage students in situations that require them to "examine their own assumptions about mathematics" (Ibid.). There, too, are teachers with a mathematics content view who act based on the belief that teaching is

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14At least based on the summary of research that Mary Schatz Koehler and Douglas Grouws wrote in 1992. Ortner (1994) claims that strain theory is more a "theory of the social" (p. 395) than it is a theory of the psychological (e.g., interest theory).
"an agent of cognitive change for the learner" (Ibid.). Hence, they develop appropriate strategies and techniques that allow the changes to occur.

**Relating Teachers' Beliefs and Practices.** The social context of mathematics teaching plays a very significant role in explaining in/consistencies between a teacher's espoused theories and beliefs about teaching and learning and her/his enacted theories-in-use and beliefs-in-practice and, at the macro level, between the intended and implemented curriculum (Raymond, 1997; Paul Ernest, 1991; Thomas Cooney, 1985; Thompson, 1984). Walter Doyle and Gary Ponder's (19xx) *practicality ethic*\(^{15}\) and the larger "socialization effect of the context" exert their influence on a mathematics teacher's enacted theories and beliefs. In Ernest's model (see Figure 2.2), it is the social context that generates differences between espoused and enacted theories and beliefs.

### 2.5 Teacher Culture: The Panopticon and the Force of Structures\(^{16}\)

Zygmunt Bauman (1973) argues that "the unyielding ambiguity of the concept of culture is notorious" (p. 1). Withering ongoing debates regarding the characterizing (= defining) elements of *culture*, I find Edward Said's notion of culture very appropriate in this study. Said writes:

I shall use the word *culture* to suggest an environment, process, and hegemony in which individuals (in their private circumstances) and their works are embedded, as well as overseen at the top by a superstructure and at the base by a whole series of methodological attitudes. (Said, 1983, p. 8).

\(^{15}\)See p. 46.

\(^{16}\)I rely on Sachs and Smith's discourse analysis on teacher culture in this summary.
Figure 2.2 Ernest's Model of the Relation Between a Mathematics Teacher's Espoused and Enacted Beliefs

(Arrows indicate "influences" or "impacts")
Said (1983) insists that culture is not merely about membership; it is about "possessing possession" (p. 9):

to authorize, to dominate, to legitimate, demote, interdict, and validate: in short, the power of culture to be an agent of, and perhaps the main agency for, powerful differentiation within its domain and beyond it too. (Said, 1983, p. 9)

Further, Said (1983) sees the need to pay close attention to that aspect of culture that deploys

a system of values saturating downward almost everything within its purview; yet, paradoxically, culture dominates from above without at the same time being available to everything and everyone it dominates. (Said, 1983, p. 9)

Perhaps there is truth to the claim that schools and schooling practices thrive in a "culture of the panopticon," both in its positivity (for e.g., acculturation) and negativity (for e.g., coercion). The Panopticon\(^\text{17}\) more than anything else individuates -- it produces subjects of power. "Everyone is caught, those who exercise power just as much as those over whom it is exercised" (Foucault, 1980, p. 156), writes Foucault. It is both an outside and an inside (Nicholas Dirks, Geoff Eley, and Ortner, 1994, p. 9): outside, it represents the perfect instrument of surveillance; inside, it is the ideal disciplinary "gaze" in which an individual becomes and then is aware that she or he is being monitored (Foucault, 1977, p. 205). It is the perfect transcendental machine that puts the burden of responsibility on the individual mainly, to turn the gaze to her- or himself simply because she or he never knows if and when she or he is being observed.

\(^\text{17}\)As Baumant (1992) insists: “Jeremy Bentham’s grand metaphor of an orderly, reason-led society” (p. xvi); described in Foucault’s *Discipline and Punish.*
Employing a Foucauldian panoptical analysis in a variety of instances and to illustrate the “force of structures,” Keith Dowding (1996) argues that “structure(s) not only affect the way people act, [the structures] also affect the way they are. ... ‘(O)urselves’ is partly constituted by the position we are in” (pp. 42-43). In this section, we discuss significant work on teacher culture. It provides the needed macroperspectival frame that this study also addresses.\footnote{Foucauldian genealogy and theories of subjectification both attempt to provide a microperspectival understanding of acts of teaching in the classrooms.}

Sachs and Smith (1988) argue that a study on teacher culture first involves identifying and understanding the asymmetrical interplay between two types of personal knowledges (not necessarily disjoint) that teachers seem to possess. Every teacher possesses a practical consciousness (or tacit knowledge) which pertains to her/his self-generated, valued, constructed, cherished, and often unquestioned beliefs that result from her/his intrapersonal interaction with her/his environment. Every teacher also possesses a discursive consciousness (or articulated knowledge) which refers to all the formal knowledges the teacher acquires and results from certain processes of professionalization and interpersonal experiences with society and colleagues (Sachs and Smith, 1988, pp. 423-436).

M. Shapiro, following Foucault, argues that constructs of legitimacy (such as language and conduct) are traced to the discursive practices that shape them. Shapiro writes:

To understand and analyze conduct, then, we must uncover the system of constitutive rules that create different meaningful episodes and objects,
or, if they are controversial, the contending systems of constitutive rules that create alternative objects, events, and kinds of conduct. (Shapiro quoted in Sachs and Smith, 1988, p. 424)

Hence, a teacher’s conduct is not traced to some stable ground of essence but is an effect of multiplex -- and often dialectical -- rules of “arithmetic of socialization.”

Doyle and Ponder’s notion of practicality ethic is important here. Sachs and Smith explain it as follows:

Particular preconditions of teaching justify the way individuals teach. These preconditions encompass institutional structures including bureaucratic imperatives, the teachers’ problematic and the hidden pedagogy. (Sachs and Smith, 1988, p. 425)

The force of the practicality ethic is simple: If it dominates a teacher’s work, then all theoretical pedagogical knowledges have no intrinsic privileged status and thus, are always already rejected and colonized (Ibid.).

Teacher culture is influenced by institutional structures in the sense that teachers’ (practical and discursive) knowledges, schemes, and repertoire are (re)creations and mediations of the schools’ policies and discursive practices. Foucault writes:

[The discursive practices] are embedded in technical processes, in institutions, in patterns for general behavior, in forms of transmission and diffusion, and in pedagogical forms which, at once, impose and maintain them. (Foucault quoted in Sachs and Smith, 1988, pp. 425-426)

Bureaucratic politics significantly shape the nature, content, and direction of the school curricula and activities. Also, teachers’ personal experiences undergo transformation, particularly in situations and times of conflict. Further, it is often the case
that they tend to "give in" to the demands set by the rules of the bureaucracy. R. Webb and P. Ashton insist that:

For some teachers, the combination of excessive demands, inadequate salary and status panic, lack of recognition and support, uncertainty, and powerlessness engender attitudes of quiet conformity and unreflective acceptance of the status quo. (Webb and Ashton quoted in Sachs and Smith, 1988, p. 428)

Teacher culture is also influenced by various teacher problematics, that is, the "given constraints" of their jobs such as: class size, school timetables (Roger Dale, 1977), teachers' personal life experiences and background (Gary Grant and Christine Sleeter, 1985), and "physical constraints ... and reluctant learners within these classrooms" (Sachs and Smith, 1988, p. 426). The problematics associated with these constraints consequently lead teachers to develop "coping strategies" (Andy Hargreaves, 1978) or "survival strategies" (Woods, 1979) that significantly influence their personal constructions -- or "cultural schemes" -- about what classroom teaching entails. Moreover, the cultural schemes "explain and justify the concrete and particularistic behaviors of teaching and the beliefs which underlie them" (Sachs and Smith, 1988, p. 426).

The politics of competent teaching involves a hidden pedagogy which involves, among other things, teaching both to control and to transmit information. A hidden pedagogy, according to Martin Denscombe, pertains to

a set of practices and methods of teaching, which is tacitly understood by teachers, which stems from practical imperatives created by the organization of the classroom and which is basic to competence as a teacher. (Denscombe quoted in Sachs and Smith, 1988, p. 427)
Elizabeth Hatton (1985) argues that teachers are always already influenced by the hidden pedagogy. Its implication for teachers concerns the Janus-faced nature of curriculum: there is a side that seriously attempts to model “humanistic, child-centered and psychologicist conceptions of teaching and learning,” and there is the other side that models “a fragmented view of knowledge” which has been transformed based on teachers’ own discursive consciousness-based experiences.

Teacher culture is also influenced by out-of-school factors: teachers’ work is to some extent a function of their experiences and background: the impact of pre- and in-service training, their perceptions and experiences about pedagogical/content knowledges. Beyond that, teachers’ middleclass background or training influences how they teach: “This is a euphemism for relatively conservative attitudes and beliefs, for an orientation into a bourgeois discourse and ‘habitus’” (Sachs and Smith, 1988, p. 429).

Further, the pervasive conservative consciousness that teachers cherish and uphold is due to the fact that (most) “teachers have in a sense never really left school” (Ibid.; see Dan Lortie, 1975). That “teachers teach the way they learned” is given a new perspective. In teacher culture theory, this phenomenon — hinged on the continuity factor — is tied to “vocabularies of motive” (Mills, 1977), an expansive term that traces teachers’ internally socialized beliefs and is often incorporated in the makeup of their practical discourse.

Teachers also participate in the practice of selective tradition: the tradition of the dominant culture — “the significant past” (Raymond Williams quoted in Michael Apple, 1990, p. 6). Teacher education courses, for instance, help maintain the interests of the dominant culture by fostering, say, a “culture of individualism” (Hargreaves, 1982) or
“liberal individualism” (Hargreaves, 1982; Dale, 1977). An attitude of individualism “selectively blinds” the “social phenomena in contrast to individualistic characteristics” (Sachs and Smith, 1988, p. 431). Further, a teacher’s behavior in the classroom is influenced by the activation of latent, prior student experiences, especially at times of conflict and tension. In teacher culture theory, those knowledges comprise a teacher’s “adaptive expediency” (Maddox, 1968).

Figure 2.3 gives a graphical summary of ideas taken up in this section. Note the graphical organization is based on my reading of the interrelationship between and among the social variables identified in the preceding paragraphs.

2.6 Summary

By way of a summary, Figure 2.4 provides a graphical representation of the rhizomatic framework that is used in this study. In particular, Figure 2.4 is a topological map of the rhizome of Solomon’s seal (or rootstock). The rhizome represents a (mathematics) teacher’s assemblage. A (mathematics) teacher has at least two kinds of knowledge that interact and one always in tension with each other. The practical consciousness is intrapersonally developed while the discursive consciousness is interpersonally constructed. Both forms of consciousness map a teacher’s regime of truth (part e). I claim that the teacher’s regime of truth (part e; a “bud”) -- always emergent and protean -- comprises of (at least) four equally, competing past, present, and emergent “scars;” the first three “scars” are related to the teacher’s epistemology, beliefs, and practices (parts a, b, and c); the social context of teaching (part d) -- a present “scar” -- is
Figure 2.3 Social Context of Teaching Model

(Based on Sachs and Smith’s Model of Teacher’s Culture)

(Arrows mean “consists of”)
both disconnected and reconnected to both past and emergent scars. The roots from the lower side of the rhizome represent ideas that are drawn from various models that are used in this study.

I need to emphasize the rhizomatic nature -- that is, the disjunctive synthesis -- of the framework. I insist that an adequate understanding of the structure of complexity of a mathematics teacher's culture involves looking at it from quite a number of paths, epistemology and social context of teaching being two of many others. Further, I should emphasize that each "scar" is framed from a particular perspective. For example, a teacher's epistemology is analyzed using Young and Fennema and Franke's model of teachers' knowledge, the social context of teaching is analyzed with Sachs and Smith in mind, and so on.

In Chapter One, I laid out two research questions pertinent in this study. The first question asks of a mathematics teacher what it means to teach mathematics in a complex environment such as an urban mathematics classroom, and the extent to which a teacher's beliefs, attitudes, and previous knowledges and experiences operate on how she or he teaches mathematics and how mathematizing occurs. More than that, it seeks to understand how the social, a protean factor, and certain conditions of existence impose limitations on classroom practices and curriculum innovation. The second question asks the genealogist (myself, the researcher) to extrapolate those pedagogical practices of mathematics teachers that subjectify students into a way of thinking about/ acting/ doing mathematics in the classrooms.
Figure 2.4 Rhizomatic Model of an Urban Mathematics Teacher’s Culture
The rhizome framework explicated in this section provides us with multiple entry paths into and a way of working through the labyrinth of a teacher's work, culture, and pedagogical practices in an urban setting. Sections 2.1 and 2.2 have been written as a way of working myself out of ideology talk, a "thinking the theory" that explores the nature of teaching (and pedagogical practices) as inscribed within power and power relations. Section 2.1, in particular, argues that subject positions are multiple and contradictory. Recalling Shroyer's question, what makes teaching difficult deals with the reality that a teacher's position is located at the juncture of so many competing Deleuzean lines. The various microphysics of power -- that is, the tools of subjectification unpacked through genealogy (section 2.3) -- that a teacher employs, as well as the conditions of existence (section 2.4) that induce a kind of panoptic effect on the teacher all represent lines in Deleuze's sense. The significance of the lines are explained in the following two paragraphs.

There are rigid lines of segmentarity: those "clearly defined segments" (Deleuze and Claire Parnet, 1987, p. 124) such as family - college - teacher. Such lines do nothing else but prepare an individual to fit her/his role in society, as a teacher of mathematics in particular. These lines induce a moving, not a becoming, but simply a passing through a segmentary. In mathematics education, for instance, we have the line joining mathematics student and mathematics teacher. Teaching mathematics involves (at the very least) learning the tools of a mathematician: axiomatic structures, definitions, theories, and (the passionless act of) acculturating into a way of thinking about and doing mathematics. Such lines generate binaristic thinking such as right solution - wrong
solution, right way to solve - wrong way to solve, mathematizing our way - not our way. They are also "devices of power." For instance, teacher education courses and the mathematics community define what and how it is to teach mathematics: they "fix the code and the territory of the corresponding segments" (Ibid., pp. 128-130). Beyond that, the lines become the substruction of an "abstract machine" that overcodes and regulates conformist practices. Such lines map a plane of organization, functioning like Foucault's episteme, and expressing a manifest desire for order, Foucault’s strict spatial partitioning of subjects.

Then there are lines of becomings, less rigid and more pliant and supple than the first kind of lines. Deleuze and Parnet write:

A profession is a rigid segment, but also what happens beneath it, the connections, the attractions and repulsions, which do not coincide with the segments, the forms of madness which are secret but which nevertheless relate to the public authorities: for example, being a teacher, or a judge, a barrister, an accountant, a cleaning lady? (Deleuze and Parnet, 1987, p. 125)

In this chapter, especially in sections 2.3 and 2.4, we deal with this kind of lines: the lines of teachers' conceptions (i.e, epistemologies, beliefs, practices), the lines of subjectification (Deleuze, 1992, pp. 160-162), the lines of conditions of existence, and the lines of norms (Pierre Macherey, 1992, pp. 176-191). They map out becomings and enclose a plane of consistence: there are only rhizomes or multiplicities. Binaries are jettisoned; rhizomes seek, but not to add, a Derridean third space "which always comes from elsewhere and disturbs the binarity of the two, not so much inserting itself in their..."
opposition as in their complementarity ... (but) tracing another line in the middle of the
segmentary line, in the middle of the segments” (Deleuze and Parnet, 1987, p. 131).

Chapter Three is about poststructural ethnography. Set within a
practically-speaking tone, I engage in a methodology talk and map the lines of validity
that are a major concern in doing interpretive inquiry.
CHAPTER 3

LOOKING THROUGH THE EYES OF ETHNOGRAPHY:
REFLECTIONS AND DILEMMAS

Poetic meanings, moral meanings, a large part of the goods of life are matters of richness and freedom of meanings, rather than of truth; a large part of our life is carried on in a realm of meanings to which truth and falsity as such are irrelevant.

John Dewey  
*Experience and Nature*

(T)he world is out there, but descriptions of the world are not.

Richard Rorty  
*Contingency, Irony, and Solidarity*

Introduction: Face-to-Face with “Reality” and the Meaning of Methodology

In *Woman, Native, Other*, author Trinh Minh-ha (1989) argues the impossibility of “coming face to face once and for all with objects” (p. 74). By an object, I refer to some natural, economic, social, cultural, political, or disciplinary\(^1\) phenomenon or object -- abstract or concrete -- that manifests its existence or materiality in some (specialized) domain of signs and discourse. More than that, if an object is bound to an idealized

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\(^1\) By a “disciplinary phenomenon,” I refer to the Foucauldian view that no discourse is innocent: that discourses exercise a kind of power that desires to control knowledge and meaning production.
“real” that is outside of a “text” or that takes the form of an epiphenomenal shadow, then “the real (shall) remain foreclosed from the analytic experience, which is an experience of speech” (Minh-ha, 1989, p. 74). Now I wonder if the foreclosure of this “real” that Minh-ha writes about implies the fulfillment of individual ontogenetic power -- “the power to create reality” (Robert Young, 1995, p. 14), one that is contingent, local, and relativist (at least relational in Bruno Latour’s sense)?

But interrogating the nature of "the real" is itself problematic. Here, by “the real” I mean an empirical world that is always already multiplexly interwoven in our own research. The poststructural move to jettison the real is difficult to accept; I do not find comfort in reducing the real to Baudrillardian orders of simulacra. For even if we construct a viable “real,” that is, invent one via the wheels of analytic experience, or insist that the real is merely socially constructed so that its meaning is an effect of (who’s) power, I sense the real "talks back." I argue that we cannot escape from the real, that we cannot simply end it, break from it, or overcome it. Researchers cannot decide for themselves how and what the real is or ought be. The symbolic interactionist Herbert Blumer (1969) writes that the real “can ‘talk back’ to our pictures of it or assertions about it - talk back in the sense of challenging and resisting, or not bending to, our images or conceptions of it” (p. 22).

Doing urban school ethnography that downplays the significance of the real of capitalism is extremely difficult and perhaps simplistic and unethical. I find it difficult to

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3 A “simulacrum” is copy with no origin. See Jean Baudrillard’s Simulacrum.
write about teachers’ and students’ actions without acknowledging the ( absent) presence of an empirical world that is conditioned by capitalism and that acts upon the school.

Urban school politics are always already imbricated within/against various competing (neo)liberal, conservative, and radical perspectives (and probably there are more). Student motivation and mathematics teachers’ work environments in Copeland High School⁴, especially, are all affected by neoliberal interests, as I have witnessed firsthand. Over the loudspeaker, students are barraged with announcements about employment opportunities and many other possible sources of work and money. That, and many other factors, contribute to the tension in this ethnographic study about (mathematics) teacher culture that I think I have not fully negotiated.

I do not mean to say, of course, that the real -- that has occupied my thoughts especially lately -- contains either the invariable presence of Truth or the fountain of our Being, or that it is immutable and fixed. In fact, the real changes over time, and itself moves in becoming-spaces. The real has a stubborn nature: it resists, it talks back. It is not a Tree, that is, a stable reference point of everything and anything. Actually, its stubbornness is brought about by its rhizomic (heterogenous, multiplicituous) nature.

The preceding “reality” talk leads me to view methodology as mainly about and consisting of “principles that underlie and guide the full process of studying the obdurate character of the given empirical world” (Blumer, 1969, pp. 23-24). This chapter is therefore a linchpin to the whole ethnographic study. In section 3.1, I discuss the nature of a poststructural ethnography. Here, I talk about ethnography as a type of storytelling

⁴ Pseudonym for the school in which data was obtained.
about others and otherness. Finally, section 3.2 is a dialogue with myself in which I
engage in validity talk.

3.1 Defining a Poststructural Ethnography

Ethnography, at least as I take it in this study, is a storytelling about others and
otherness. It is a kind of storytelling that, according to Hannah Arendt, “reveals meaning
without committing the error of defining it” (Arendt, 1968, p. 105). And following
Walter Benjamin’s (1968) notion of the usefulness of storytelling, the meanings,
narratives, and case studies that I present in this study are all attempts to “counsel” the
ongoing relations in Copeland High School. Benjamin writes, “Counsel woven into the
fabric of real life is wisdom” (Benjamin, 1968, pp. 86-87). Yes, indeed. But this wisdom
employs poststructural theorizing in that it maps rhizomes and their multiplicities in
celebration of the “freedom of meanings, rather than of truth” (Dewey, 1958, p. 411), to
use Dewey’s words.

All ethnographic study is about others and otherness. Steve Woolgar writes:

Ethno-graphy means literally description from the native’s point of view: rather than imposing one’s own framework upon the situation, the
ethnographer tries to develop an appreciation of the way the natives see things (Woolgar, 1988, p. 84).

... We want to see things from the natives’ point of view but we don’t want
uncritically to adopt their belief system. (Woolgar, 1988, p. 86).

Echoing Frederick Erickson, Harry Wolcott (1997) insists that ethnography is not a
"reporting process" but an "inquiry process carried out by human beings and guided by a
point of view that derives from experience in the research setting and from the knowledge of prior anthropological research" (p. 333).

But seeing things from the native's perspectives, describing what one sees, and reporting it are different ideas altogether. Which also means to say that the idea of a disinterested observer is problematic. Linda Alcoff raises the issue of “speaking for others”:

There is a growing recognition that where one speaks from affects the meaning and truth of what one says, and thus one cannot assume an ability to transcend one's location. (Alcoff, 1991, pp. 6-7)

...Who is speaking to whom turns out to be as important for meaning and truth as what is said; in fact what is said turns out to change according to who is speaking and who is listening. (Alcoff, 1991, p. 16)

Indeed, Alcoff (1989) is right when she insists that our own biases and prejudices, and our own truths and constructions are linked to where we are located or where we choose to locate ourselves. Our “life experiences,” Renato Rosaldo (1993) writes, “both enable and inhibit particular kinds of insight” (p. 19). Let me relate two instances. First, my being an Asian manifested itself in not a few uncomfortable moments while in the field. The (urban) classroom culture in the Philippines is different, perhaps at the superficial level, from the (urban) classroom culture here in the United States. While in the classrooms here, I could simply not get used to the continuous disruptions. “Floaters” were all over the place; they were in and out of the classroom. So many students never brought pencils and paper during math time. They expected their teachers to give them whatever they needed. If a student didn’t have a pencil and s/he needed one immediately,
s/he could buy from her/his teacher on the spot, and this would already disrupt a classroom discussion in process! It seemed to me that there were unnecessary and excessive amounts of negotiation that teachers and their students did in the classrooms.

Another instance of the significance of a speaker's location deals with the nature of mathematics and mathematizing. For me, the meaning of mathematics, as well as meaning making in mathematics, underwent radical changes over the two years of my stay here in the United States. It used to be that mathematics was all about signs and symbols, and equations and problem solving. I was then guided by the "naive mathematicians' dogma" which, according to Morris Kline (1977), involves seeing to it that mathematizing and teaching mathematics is but a simple matter of providing, in a clear and organized manner, a more than sufficient amount of symbols.

Now I view mathematics as being more a language and less a "science" of patterns. Learning mathematics is like learning a type of language in which the dialogic method is exhaustively utilized. Teachers and students need not just do math, but they need to talk about it. The dialogic method encourages individuals to view speaking and talking about mathematics as demystified activities; it also fosters an attitude of self-reflexivity in the act of mathematizing. What became problematic, which I think I never settled, was my attitude towards how my teacher-participants taught mathematics: they all simply lectured, with degrees of student participation ranging from interactive to simply none at all. Of course, what resulted from these "dull" experiences for me has resulted in a productive wandering into the nature of subjectifying practices. (See Chapter Six.)
Poststructural ethnography does not employ a unique set of methodology and procedures in the gathering and analysis of data. There is nothing exceptional about its methods, whatever those are. It is still conventional ethnography (Jim Thomas, 1993, p. 19). However, poststructural ethnography foregrounds an ethnographer’s self-reflexivity: I (we) enter in a deconstructive relationship with an object of knowledge to be investigated. I (we) become more self-critical about how to pin down “the ‘real’ in the ethnographic account and to theorize, in explicit terms, the politics of recounting and being accountable” (Deborah Britzman, 1995, p. 231). This self-critical disposition has been brought about by successful deconstructivist efforts, troubling taken-for-granted binaries such as true/not true, knower/known, and researcher/researched. Also, following Peter McLaren, the ethnographies we produce are diffused effects of power, social practices, and "normative understandings" (McLaren, 1992, p. 80). Once again, thinking of Gilles Deleuze and Felix Guattari, I wave my hand and say: “We’re tired of trees. We should stop believing in trees” (Deleuze and Guattari, 1987, p. 15). There is no pure essence, no pivotal unity, no hierarchy in which the privileged top node is located above all the remaining nodes. There are only “meaning systems negotiated and constructed in and through relationships” (Robert Emerson, Rachel Fretz, and Linda Shaw, 1995, p. 216), through rhizomes.

This foregrounding of self-reflexivity needs further explanatory unpacking, especially because I drew my data largely on teacher accounts (through interviews) and my own personal experiences (as a "disinterested observer"). Self-reflexivity has strong implications on how we (or I) conduct the “science” of poststructural ethnography. In
Culture and Truth, author-anthropologist Rosaldo argues the significant double implication of personal experience. I explain this in the context of my own research experience. Having personally experienced how it was to live in the classrooms of my participants -- pretending to be just like anybody else, sometimes boring myself to death in my seat -- became a tool for understanding the impact of subjectification and subjectifying practices in students' lives. Now it seems possible to write, with much gusto, about student resistance because the writing itself is far from detached. From the other end, my personal experiences with the teacher-participants - witnessing how they cope with “extremely apathetic and lazy” students (to use Mr. Jack’s words), for instance -- has made my writing more intense and situated. However, to justify my case by drawing on these personal experiences (i.e., using personal experience as an “analytical category”) very much “risks easy dismissal” (Rosaldo, 1993, p. 11). Am I presenting merely case stories or case studies^ (Douglas Roberts, 1996, p. 244)? I say both: we learn as much from the stories as from a critical analysis of the stories.

One last point. Interpretation in poststructural ethnography is a self-reflexive undertaking, too. As I have extrapolated in various parts in this section, I claim that my interpretations (and hence, conclusions) are, at best, provisional. Rosaldo explains this well in the following sentences:

^ Roberts (1996) seems to privilege case studies over case stories, and insists case stories analogically correspond to “data tables” in quantitative studies. He goes on to argue that a case story is “essentially a narrative presentation of data, but one that lacks a point and does not make an argument” (p. 244, italics mine). Although I myself am critical of merely case stories, I am careful not to generalize. Some narratives, like those of Jonathan Kozol or race and feminist stories, only illustrate their justificatory and explanatory power without belaboring their points. The stories are the case studies themselves.
All interpretations are provisional; they are made by positioned subjects who are prepared to know certain things and not others. Even when knowledgeable, sensitive, fluent in the language, and able to move easily in an alien cultural world, good ethnographers have their limits, and their analysis always are incomplete. (Rosaldo, 1993, p. 8)

3.2 Validity Talk: The Politics of Generating Data and Justifying Evidence

Doing science, in whatever paradigm of consciousness one subscribes to, means engaging in validity talk. Although the term itself invites contestation (i.e., questions such as what constitutes validity, or whose notion of validity, etc.), this ethnographic study expresses a desire to play the politics of validating knowledges. In this section, I discuss standard validity concerns such as credibility, transferability, and dependability. Towards the end, I engage in a brief discussion of validity within the poststructural moment.

Following bell hooks, I decided to engage in a dialogue with myself⁶. The dialogue format made it possible for me to be both formal and informal about my ethnographic experience. After all, doing fieldwork and gathering data, in general, involve coming to grips with the messiness and the informality of ethnographic knowing.

Q: So how many weeks did you spend collecting data?

Ten weeks.

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⁶ See hooks, 1993, pp. 146-154. One day, I found it too difficult to even begin writing this chapter simply because I felt it was simply a desire to please the validity icons. I've always resisted thinking and writing about validity so much so that, in the past, the end products have mostly been deified summaries of who said what and why, framed in a clever dada style. I thank Patti Brosnan for suggesting that I talk to myself and talk only about issues that interest me. Well, it turned out to be a most meaningful experience.
Q: Was it necessary to spend ten weeks in the field, and why so?

Yes. Because this study was concerned with the ethnography of mathematics classrooms with a particular interest on teachers' culture, it was the only obvious choice. I thought that the need to "soak one's self" in the field is a purposeful maneuver simply -- and mainly -- because of my fundamental belief that participants almost always live in "ambiguity, spontaneity, and improvisation" (Rosaldo, 1993, p. 92). I waited until focal moments transpired in which certain conditions (e.g., themes, experiences) pertaining to the study have somehow sorted themselves out, and that took ten weeks. Classic ethnography has it that people are guided by rules of behavior (Ibid.), but that is an illusion. For ten weeks, I struggled, along with the four participants in my study, with Copeland High's alarming rate of student absenteeism. It was important for me to experience my participants' culture, their work environment, their joys, their successes, their pains, and their frustrations. All these became necessary in order to reduce distortions, and to avoid miscontextualization and unfair impressions that I may have had at certain points.

Also, I needed enough time to conduct classroom observations. I never liked the idea of conducting interviews without extensively observing how my participants acted in the classrooms. The observations provided the depth I needed to understand what my participants were saying about certain issues. For instance, all four of them insisted that the issues of race, culture, and gender were not significant in the teaching of mathematics. I needed to understand why they were all saying that.
Q: *Was ten weeks long enough?*

*Yes, because to some extent I knew what my research questions were. I conducted a pilot study in the same school with a different teacher last Winter 1997 and that helped me configure how to conduct this formal research. The pilot study was also useful in narrowing down the focus of my intended research, from something that's overwhelmingly difficult to do to something that's do-able. The pilot study was a preliminary stage in which I deliberately allowed myself to experience confusion, make mistakes, over-react to nonessentials, and focus on both trivial and nontrivial concerns. In this research, it was a matter of understanding the thoughts, actions, and -- most importantly -- intentions of my participants and seeing to it that "distortion" is minimized and context is properly elaborated. From the pilot study, I learned the implications of ignoring context and participants' intentions and, consequently, how "dangerous" and unethical the reporting of data turned out.*

Q: *What if you had isolated cases? Aren't those considered data? Isn't it the case that you are not too concerned with generalizability, anyway?*

To the first question, yes, isolated cases are still data. But one needs to make sure that those cases are indeed peculiar, sort of like outlier cases in statistical lingo. Here, I am reminded of Emerson, Fretz, and Shaw (1995) when they argue that frequency is just one aspect of analysis (p. 162). Sometimes having only one case works out just fine simply because the case itself carries with it great theoretical insight and relevance.

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7 The pilot study I conducted with a white, male secondary mathematics teacher focused on "unpacking" the regime of truth he deploys in the classroom. The data I reported failed to explain his intentions from a rhizomatic frame which left an impression that his pedagogical practices were coercive and unjustified.
Quantitative researchers almost always ignore outliers, but I think of an outlier as representing a perspective that promises to make theorizing more meaningful and difficult. Having $n \geq 2$ cases does not make justification and analysis any better, at least from an interpretive perspective. The patterns say one thing, but it is another thing to investigate and understand when two or more instances are similar or are different. Having a pattern does not mean manifesting the same characteristics throughout all time. That is positivist illusion.

Let me illustrate an isolated case that I had to deal with in this study. Ms. Lynch, one of my four participant-teachers, likes to innovate in class. She likes to use manipulatives and worksheets that enable her students to learn mathematics better and easier. But do not expect her to use computers to teach mathematics, or to lend her students graphing calculators. She relates two unfortunate incidents she had last schoolyear 1996-1997. The first one dealt with computers. After she conducted a session on mathematics with the aid of computers, she later found out that some computer parts/devices (mouse, in particular) were stolen. Of course, she was held responsible for the lost items. The second one dealt with graphing calculators. Any student who did not have a calculator could borrow one from her. Later, as soon as she got them back, she noticed that some button keys from several calculators were missing; they were plucked out from the calculators! Now what makes this case unique is that the three other participant-teachers have not experienced this. Ms. Lynch's case is theoretically significant because it provides one possible dimension to understanding how personal
experience, more than anything else, can impose a limitation on implementing innovations in the math classrooms.

Concerning generalizability, when I use “anyway” in the question, it does not mean I am refusing generalizability. One does ethnography with the presupposition that cultures vary, and here I mean cultures in the broadest sense possible. Of course, I delight in the idea that my narratives can contribute to a better understanding of some specific phenomenon in a “general” sense or more strictly, that the analysis I make might have universalizing power, that is, it can be applied to, say, any teacher culture. But I have come to accept that colonial desire as a pernicious research practice. I am reminded of an interesting remark made by Adrienne Rich (1977): “When someone with the authority of a teacher, say, describes the world and you are not in it, there is a moment of psychic disequilibrium, as if you looked into a mirror and saw nothing” (quoted in Rosaldo, 1993, p. xxi). But what if you were in it and still, you saw nothing? That fully captures what I perceive to be a noxious (intentional or otherwise) effect of generalizability.

Q: So if you claim that the search for generalizability is a pernicious practice, then aren’t you worried about relativist-motivated research?

No. Drawing on Bruno Latour’s discussion of relativism in We Have Never Been Modern, I view relativism as being more relational than absolute. In lieu of generalizability, I prefer transferability. It responds to the concern or to the possibility that a reader or another researcher may find, say, my research applicable in her/his own
setting. That is why thick descriptions are necessary so that the reader can make a judgment regarding transfer (Yvonna Lincoln and Egon Guba, 1985, p. 313).

Q: How did you satisfy thick description?

For the record, there is no agreed criterion (Ibid., p. 316). In Chapter Four, I made sure that I wrote sufficient descriptions of Copeland High, the culture of the students there, and the work environment of the participant-teachers. Also in that chapter, each participant's beliefs, attitudes, and previous mathematical experiences and background were laid out carefully so that any teacher who may want to read the accompanying analyses may be able to figure out if the situational analyses and the whole ethnographic study applies to her/him.

I keep thinking about Norman Denzin's notion of "thick description" as "contain(ing) the necessary ingredients for thick interpretation(s)" (quoted in Michael Patton, 1990, p. 430). In a significant way, the rhizomatic theme that this study subscribes to anticipates Denzin's insistence on meaningful interaction of meanings.

Q: What methods did you use to collect data?

Observations, interviews, two survey questionnaires, and document analysis. The documents included textbooks, the school mathematics curriculum, handouts, worksheets, and quizzes.

Q: So how did you conduct your observations? And what problems did you encounter while you were doing your observations?

Observations never came easy for me mainly because I struggled with and against my participants. I struggled with Ms. Lynch, most especially, because stepping
into any of her six classes was like "going to war" mentally and emotionally. There was
an absence of control in her classes. But she could teach, if only certain conditions of
existence were in her favor. I struggled against all four of them because they lectured
most of the time. Being in their classes with all my Foucauldian radar up and swinging
round was really tough to negotiate.

Every now and then during those ten weeks, I would see Suzanne Damarin and
lament about what I thought was "dull" data. Frankly, I was expecting a "rich" mine field
full of interesting data. It didn’t work that way. I remember Robert Boostrom’s (1994)
advice: "The classroom will teach the observer who is patient and wants to learn" (p. ?).
Well, I had both patience and readiness to learn. But the classroom was a difficult
"teacher." In section 1.2 of Chapter One, I argued that each mathematics classroom is
singular, a difference-in-itself. Now each of my four participants taught six sections.
That meant learning from twenty four "teachers," and that drained me, both emotionally
and mentally. There were times, too, when I asked what I could learn from a
teachercentric classroom in which students have been so subjectified into a state of
emotional neutrality\(^8\).

I read pertinent books and articles on observation that I could get my hands on,
but there was nothing like the real thing. I remained a disinterested observer, I think, but
that did not keep me from playing various roles during those ten weeks. In the first week,
I was an observer-as-participant with a clear, selfish goal: To obtain data. Then came the

\(^8\) See 1.2.2.
time when I became a peripheral member: I was in the classrooms to experience a native’s perspective without fully participating. When my teachers lectured, I reacted like a student: most of the time I listened (although I was really tempted not to); like some students, sometimes I read, and on more than one occasion, I slept (unfortunately). The final stage of my membership was playing a partially active role, especially in Ms. Lynch’s classes. Ms. Lynch announced in all her classes that I was there to do research and to assist her. In one of her classes, students turned their interests more to me and less to her. These students saw in me a solution-generating machine. They needed me because I could answer all their questions. There were uncomfortable moments like when students would compare both our styles, often to Ms. Lynch’s disfavor. Those were moments, too, when I was so tempted to tell those students that part of learning mathematics involved learning how to listen and to respect.

Patricia Adler and Peter Adler (1994) argue that all observers need to go through these stages, from covert to overt, passive to active, outside to inside. We must allow these role shifts to occur so that our presence is demystified in the process, and thus enabling us to transform from researcher to member. We simply do “not (want) to alter the flow of the interaction unnaturally” (p. ?).

I think the most important thing that I gained from doing observations dealt with the powerful experiential phenomenon that feminist Gloria Anzaldúa, author of Borderlands: The New Frontera (The New Mestiza), has referred to as la facultad. She writes, “la facultad is the capacity to see in surface phenomena the meaning of deeper realities, to see the deep structure below the surface. It is an instant ‘sensing,’ a quick
perception arrived at without conscious reasoning" (Anzaldua, 1987, p. 38). (This “deep structure” needs to be qualified. I am aware of the Foucauldian concept of exteriority here, and I share Foucault’s view that we ought to stop desiring deep structures and make the Nietzschean move: accepting that “everything is already interpretation” (Foucault, 1967, p. 189). Foucault also reminds me of the impact of power/knowledge.) When Anzaldua (1987) refers to “deep structure,” I choose to misread her and say she means “you just know from a distance,” that “you know it because of the impact of ‘immersion’ from doing persistent observations. I think towards the end of my field observations, I acquired this Anzalduan “skill.” To some extent, I could actually “read between” interactions between my teacher-participants and their students. I could somehow sense why my teacher-participants acted the way they did at particular points, without having to ask them about the action of concern. In Chapter Five, I deal mostly with my observational analysis of classroom talk and a lot of times, I was relying on my *la facultad*. Again, my *la facultad* could be wrong, of course. So, in order to avoid any intentionally “distorted” reading of other people’s actions, I tried to make sure that my observations were focused on the essential points.

Q: *How about your interview experiences?*

I conducted two formal interviews with each teacher-participant, several informal and short interviews, and a membercheck as a type of interview. Each formal interview lasted 50 minutes, and was typically held during a participant’s conference time. I thought about conducting a focus group interview but the four participants were assigned different conference periods. It was just difficult and seemingly impossible to find a
common time for all five of us to meet. Also, I was not comfortable with the idea of asking people for an extra time after school hours for more talk, especially given the nature of my research. I always had to remind myself that they were "volunteers" in the study. And I could sense that they valued whatever time they had alone for themselves.

In the first interview, I prepared a uniform set of questions that inquired about my participants': teaching experiences in an urban setting, beliefs and attitude towards mathematics and mathematics teaching, prior mathematical experiences (as early as high school), knowledge of current school math reform, sense-making with respect to constructivism, notion of an ideal mathematics student (or an ideal math class), and thoughts on issues of race, culture, and gender (see Appendix B). The second interview was based on classroom observations and follow-up questions from the first interview (mostly clarificatory in nature) and the first survey questionnaire. Each participant responded to a set of questions that had been tailor-made for her or him (see Appendix C). Prior to the membercheck interview, each participant was given a month to read through Appendix A. Then, a membercheck was conducted (see Appendix D). In the membercheck, I wanted to make sure that my understandings of their responses were clear and context-based.

I view an interview as a performance of the self (i.e., the interviewee's) and of course, it is a "conversation with a purpose" (R. Kahn and C. Cannell quoted in Marshall and Rossman, 1995, p. 80). In In a Different Voice, author Carol Gilligan (1993) points out that when we conduct interviews, we "follow the language and the logic" of our
interviewee’s thoughts (p. 2). In my case, although I had a set of questions, I was prepared for an unstructured and informal encounter. And that’s what actually happened. The “ideal” sequencing of questions was abandoned. One (and two) line responses needed more explanation, and so I asked more follow-up clarificatory questions.

I think the most satisfying -- but nevertheless problematic -- meaning of an interview is that it is, in Jay MacLeod’s (1995) words, “partly an exercise in self-justification” (p. 301). Moreover, MacLeod (1995) insists that “interviews alone have to be accepted at face value” (p. 301). No one person is ever consistent. It is possible for an interviewee to say different things in different contexts, or to say one thing and do a different thing. In other words, either the interviewer gets inconsistent interview responses from the same person, or the observations and the interviews frequently do not match. The way I dealt with the former situation was to keep asking the same question every so often until a modal response was emerging. In the latter situation, I relied on (the frequency of) my observations more than the interview response because of my belief that data from in-depth observations stand to have more impact on school change than data from interviews. I mean here that how teachers teach affects classroom life more directly than what they say about the way they teach.

Let me illustrate the latter situation. The first interview included a question about what teachers think about what mathematics is. Mr. Jack, one of my participants, responded as follows: "How do I define mathematics? (...) Ahh (...) I guess I would define it as using numbers, systems, and theories and concepts I guess as it gets applied in everyday situation." It was hard for me to accept that claim at face value because the
knowledge I gained from the in-depth observations was different. While it was true that he used “numbers, systems, and theories and concepts,” I did not witness Jack teaching any application problem, one that really involved the application of those concepts in “everyday situations.” Of course, there was much I didn’t know about Mr. Jack then.

Q: *What's the point in getting documents from your field?*

An “unobstrusive method” (Marshall and Rossman, 1995, p. 84) for gathering data, documents provide many interesting insights that cannot be fully obtained from interviews and observations. I learned a lot when I did a content analysis of the school mathematics curriculum and the textbooks. The words used in the documents have clear Foucauldian implications. The mathematics curriculum clearly spelled out how the algebra sequence for a noncollege bound student differs from that of a college bound student. More of this kind of document analysis is given in Chapter Five.

Documents such as written examination sheets, quizzes, handouts, and activity sheets unpack some elements of “hidden agenda.” In my case, they gave me vital information about what knowledges were valued, how those knowledges were institutionalized from a didactic perspective, and what cognitive levels were emphasized.

Employing a content analysis, I raised the following points: Were questions raised designed simply to measure how much information could students retain? How many of the questions were recall questions? From a Foucauldian perspective, such documents can be viewed as part of a teacher’s subjectifying practice: students as math learners -- as epistemic subjects -- constitute themselves (at least in part) based on how they are tested.

Q: *Why was it necessary to conduct surveys using questionnaires?*

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The goal of the first survey questionnaire (see Appendix E) was to help my participants situate themselves with the objectives of the study. The questionnaire was administered to them towards the end of the second week of the study. The questionnaire consists of two parts. The first part deals with demographics such as marital status, age, race/ethnicity, salary, undergraduate and/or graduate degree(s) obtained, and membership in professional organizations. The second part consists of forty-five questions on a 5-point scale that deal with matters that affect mathematics teaching and teaching, in general. Most of the questions were obtained from the University of Chicago *Opportunity to Learn* questionnaire (see Rochelle Guttierez, 1995).

The second grounded survey questionnaire also consists of two parts (see Appendix F). Part One is demographics. Participants were asked to reveal the number of years they have taught at Copeland High School and in an urban school setting. Part Two consists of forty questions on a 5-point scale that were extracted from the interviews and the observations. I was interested to know if all four of my participants shared similar views on certain matters. Items of convergence and divergence made for interesting insights and provided further possibilities for analysis.

Q: *You claim to be doing a poststructural ethnography. Do you have to deal with special types of validity?*

Actually, no. While it makes sense to view validity as an incitation towards a type of social scientific *rigger*, I choose to view it differently. "Rigger" and "validity" are words that seem to connote a certain desire for transcendental status, outside of a "text"
that invented them both. Further, both implicate a normative dimension that, I think, goes against the poststructuralist epistemology. Hence, doddering within the poststructural current, I define a transvalidity that is an incitement towards greater reflexivity. By reflexivity, I mean the term as Latour (1992) defined it: "any text that takes into account its own production and which, by doing so, claims to undo the deleterious effects upon its readers of being believed too little or too much" (p. 166).

Q: Say more about transvalidity.

My thinking about transvalidity follows that of Nietzsche's "transvaluation:" it is a value-reassessment of modern values (such as fetishism, compassion for sufferers and equality of rights) in terms of how those values make possible a man's transformation into a higher human being. Nietzsche's value-reassessment leads to a new culture of men that restores and privileges those values that have been displaced by modernity (e.g., democracy, socialism, and Christianity)⁹. Douglas Smith (1996) views a Nietzschean transvaluation as a "re-valorization of an object or concept by those forces which appropriate it" (p. 1).

So, a transvalidity implies the restoration and revalorization of those validity concerns that have been displaced by modern science, such as reflexivity. Beyond validity, transvalidity is concerned with the performance of viability (as against the empiricist-based conception of validity) which I found very difficult to fully grasp

because of my tendencies time and again to slip back to what I thought were "realist" performances.

Thinking of Lincoln and Guba’s validity criteria in a different way (i.e., as a consequence of transvalidity), I gather that researchers need to self-reflect and to consider the extent to which the data they obtained from their own studies have been adequately produced and read with sufficient attentiveness to detail. Roger Simon and Donald Dippo (1986) insist that “most ethnographic data is ‘produced’ and not ‘found.’” (p. 200). Which means to say that “we need to recognize our own implication in the production of data and thus must begin to include ourselves (our own practices and their social and historical basis) in our analyses of the situations we study” (Simon and Dippo, 1986, p. 200)

Q: What ethical issues did you have to negotiate with yourself?

First point. Rosaldo (1993) insists that "(t)he choice of what we want to know is primarily political and ethical" (p. 224, italics mine). Again, I reiterate the idea that the choice is far from ideological as I have explained in detail in Chapter Two. I must admit that my interests in postmodern social science, particularly constitution and subjectification, have significantly influenced the lens I used all those times I was in Copeland High gathering data and possible exemplars. More to the point, instead of a grounded-theory ethnography, my own research work exemplifies a theory-driven ethnography in which, according to John Johnson and David Altheide, "field observations and data are used as exemplars for illustrating the theoretical orientation or commitment of the observer-author, chosen or selected on extrascientific grounds by the
observer prior to making the observations" (Johnson and Altheide, 1990, p. 27). I will go back to this shortly.

Gerard Boomer (1987) argues that "educational writers have been prone to stigmatise and stereotype teachers, reducing them to types and styles; speculating, often patronisingly, about intentions and designs" (p. 5). Mathematics educator Michael Battista (1994) argues that "many teachers have beliefs about mathematics that are incompatible with those underlying the reform effort" (p. 462), that is, the regime of constructivist reform. Thinking about Boomer's observation in this case, we probably can identify different kinds of mathematics teachers: the undesirable teachers who view mathematics as a set of procedures, the somehow desirable teachers who do whole-class interactive lecture (in which both teacher and students are engaged in a "discussion"), and the most desirable teachers who are constructivist-inspired. There are more, of course, but I only identified three to stress the pernicious practice of "labeling." I have often asked myself the following questions: If a mathematics teacher practices her/his discipline as mainly a set of procedures, does that make her/him a less effective and desirable teacher? If mathematics is viewed as a language, does having a meaningful syntactic knowledge presuppose a successful semantic knowledge? In 1995, Gregg further caused a tension by presenting a dichotomized view of pedagogical practices in school mathematics: the demonized traditional practices versus the angelicized (fill in the blank with the correct learning theory)\(^{10}\)? I ask the questions: What does a constructivist program really do? And ... where is the SOCIAL -- in the broadest sense -- in school math reform?

\(^{10}\)I argue that the issue of a "final," general adequate theory of mathematical learning is and will never be resolved. I predict that research on theories of mathematical learning in the new
The preceding paragraph has led me to think that, especially after reading the history of school math reform in the last forty years, two fundamental questions remain unanswered: (1) To what extent do certain conditions of existence impose their limitations on how mathematics teachers implement reform? (2) How do mathematics teachers -- by using the discipline of mathematics -- contribute to the shaping of the modern society, so conditioned by discipline, regularization, and a desire for order and classification?

A second point regarding ethics. As mentioned in section 3.1, Woolgar claimed that ethnography is "description from a native's point of view." It goes without saying that ethnography means literally intruding into other people's lives. The issue of anonymity is far from simple. For me, the issue is never about simply changing my participants' real names and allowing the course of life to move on. The rest of the world may not be able to find these people, but I worry about that "epsilon interval" (neighborhood) in which their lives are located. Their colleagues knew that I was conducting research with them on teacher culture in an urban setting. Their administrators knew that I would generate sensitive information about Copeland High such as the status of reform (if ever there was one) and the alarming rate of student absenteeism. The school district also knew about their participation in my research.

To resolve these, each was asked to sign a permission/consent form (see Appendix F). Then a collaborative reading was conducted with each participant (see Appendix C for membercheck protocol). The reading was an important activity because I millenium will shift to Vygotsky and hermeneutics (following Tony Brown, 1997).
was not fully immersed in their culture. I never even had any experience teaching in an urban high school here in the United States. Nevertheless, I insist that my goals outweigh the lack of experience. One of my goals is to widen the conditions of possibility for understanding why mathematics teachers do what they do and do what they can do to survive in the urban classrooms. Another goal is to contribute to the growing literature on empowerment pedagogy by unpacking the multiplex conditions of existence that impose their limitations on teachers' work environment and their lives in the classrooms.

Finally, the chapter on subjectification (Chapter Five) involves the ethical dimension of analytic interpretation. Any reader or researcher who does not subscribe to my paradigmatic orientation may ask: Do I really perceive a form of subjectification, or am I guilty of the sin of Jourdain (a didactic term that means “the power of scientific speech to make familiar activities sacred” (Guy Brousseau, 1997, p. 26))? Again, I echo Simon and Dippo's belief that critical ethnographic data is produced and not found. The reality that I produce in this discourse necessitates a subjective politics of seeing that is "implicated in the work of reality-construction" (Paul Atkinson, 1990, p. 7). The chapter also foregrounds the difficult task of problematizing common sense and those taken-for-granted assumptions about urban school culture, classroom talk, and classroom discourse such as the significance of school mathematics in society, the role of signifiers in school math textbooks, and so on. This is what the (critical) poststructural project is mainly about, and this is very important: "that we subvert a view which constitutes existing forms of social life and social consciousness as obvious, natural, and taken for
granted" (Simon and Dippo, 1986, p. 198). Perhaps it is not only a matter of subverting a view, but of displacing that view, too.

Q: So how did you report and analyze your data?

I relied mostly on Michael Patton’s suggestions when it was time to do a formal, rigorous data reporting and analysis. All the time I was doing field work, I was already immersed in partial data analysis. Which means to say that if my *la facultad* was telling me that I needed to investigate a possible theme or idea, then I would write on my journal “________: Theme/s of the Week,” and would focus on exploring such theme/idea for at least the next week or until such a time as I would feel there’s enough data to warrant the observation.

Appendix A provides descriptive data of the teacher-participants in this study, as well as the kinds of students that study in CHS. Concerning student culture, I relied on two sources: one from my own observations and experiences (especially working with students during math time), and another from Ms. Walters, counselor for seniors in CHS. Concerning data about the teacher-participants, I relied mainly on the interviews. Because I was interested in secondary mathematics teacher culture in an urban setting and a Foucauldian analysis of mathematics teaching, I decided to write four separate case studies. Each case study consists mostly of condensed interview excerpts and the results of the two survey questionnaires. Data from observations are simultaneously reported and interpreted in Chapters Four and Five. The goal of writing a case study for each teacher-participant has more to deal with my concern of “tak(ing) the reader into the case situation” (Patton, 1990, p. 387), that is, to situate the reader (and myself, of course) for
the analyses presented in Chapters Four and Five. I wanted to make sure that before readers are presented with, say, a typical classroom interaction in Mr. Jack’s class, at least the reader has a “pretty comprehensive” idea about where Mr. Jack was coming from — his epistemological positions, beliefs, prior or previous mathematical and teaching experiences, etc.. That would enable the reader some space to judge for her/himself whether my analyses and conclusions are indeed warranted.

Each case study was organized rather loosely around Paul Ernest’s model of a mathematics teacher’s knowledge, beliefs, and attitudes. Table 3.1 below gives a summary of Ernest’s model.

Two different levels of analysis were used in Chapters Four and Five. Having written a case study for each teacher-participant in Appendix A, in Chapter Four I did a cross-case pattern analysis of the individual cases (Patton, 1990, p. 385) through an inductive process. Patton (1990) identifies several inductive processes, but only two apply in this study: sensitizing concepts and analyst-constructed typologies.
| Knowledge                                       | of mathematics                          |
|                                                | of other subject matter                 |
|                                                | of teaching mathematics --              |
|                                                | mathematics pedagogy and               |
|                                                | mathematics curriculum                 |
|                                                | of classroom organization and          |
|                                                | management                              |
|                                                | for mathematics teaching               |
|                                                | of the context of teaching mathematics  |
|                                                | -- the school context and the students  |
|                                                | taught                                 |
|                                                | of education -- educational             |
|                                                | psychology, education, and             |
|                                                | mathematics education                  |
| Beliefs                                        | conception of the nature of            |
|                                                | mathematics                              |
|                                                | models of teaching and learning         |
|                                                | mathematics -- model of teaching        |
|                                                | mathematics and model of learning       |
|                                                | mathematics                             |
|                                                | principles of education                 |
| Attitude                                       | to mathematics                          |
|                                                | to teaching mathematics                 |

Table 3.1 Ernest's Model of a Mathematics Teacher's Knowledge, Beliefs, and Attitudes

"Making the Obvious Obvious." Sensitizing concepts are concepts that analysts "bring to the data" (Patton, 1990, p. 385) as a result of prior research studies, a review of research literature or ideas that have been posited because they form part of one's conceptual framework. Patton writes, "The inductive application of sensitizing concepts is to examine how the concept is manifest in a particular setting or among a particular group of people" (Ibid.). For instance, I used the sensitizing concept "round robin absenteeism" (section 4.1) as a way to explain the phenomenal frustrations that all four teacher-participants experience in the mathematics classrooms. Note that the concept is
simply a term I used to explain what the teacher-participants said about student absentees. Teacher's "sense of isolation" (also in section 4.1) is another sensitizing concept. Both sensitizing concepts are terms that the teacher-participants in this study did not explicitly say themselves (otherwise, the concepts become indigenous (Ibid., pp. 390-391)).

"Making the Hidden Obvious." Analyst-constructed typologies, I believe, are of second order rank in the inductive process. Patton (1990) writes, "the analyst assumes the task of constructing and making explicit patterns that appear to exist but remain unperceived by the people studied" (pp. 398-400). The analyses of some sections in Chapter Four and the entire Chapter Five are all based on typologies I constructed for use in this study. For instance, with respect to teacher epistemologies, I used a 2-type typology: relational and impersonal (see section 5.2); with respect to teacher beliefs, I identified four types: primary-central, primary-peripheral, derivative-central, and derivative-peripheral; and so on.

"Making the Hidden Even More Obvious." Chapter Five also deals with what I define as theoretically-driven concepts. These are concepts that illustrate a particular theoretical perspective. The conceptualization of theoretically-driven concepts is inspired from Johnson and Altheide's notion of a "theory-driven ethnography" (see p. 78). For instance, I claim in Chapter Five how mathematical rules predispose students to a kind of mathematizing in which the focus is on the mastery of signifiers rather than a personal understanding of a mathematical concept. That situation illustrates Lacan's discourse of the Master. Also, through some interview pieces, I claim that students' mathematical abilities are constructed by their teachers rather than based on themselves. Both ideas of
students abilities and subjectivities illustrate Foucauldian notions of normalization and subjectification.

Q: So how did you check the "viability" (versus "validity") of your typologies?

Of course, triangulation is very important. Also, I read my data over and over again until I was convinced that it was indeed possible to characterize the elements in a typology. For instance, when I read Marcia Baxter Magolda’s (1995) different modes of knowing (relational, impersonal, contextual), I was so elated because I thought she was "speaking to my data," that is, the way she constructed her epistemological typologies "converged" with my own observations. Alba Thompson’s (1992) research on different kinds and degrees of beliefs (primary-central, derivative-periphery, etc.) explain very well my teacher-participants’ belief systems. Even if no numerical survey was done, the observations (classroom interactions) and the interviews were both very powerful methodological tools in clarifying the nature of a particular belief.

Also, I employed a peer debriefer who acted as my "critic" throughout the study. For instance, in framing my idea of a gendered nature of mathematics teaching (i.e., relational or impersonal), I showed him several classroom episodes and on the basis of my coding scheme and description of relational versus impersonal deployment, I asked him to classify the episodes accordingly. Both of us ended with almost similar characterizations.

Q: Is there anything else?

This dissertation, more than anything else, is a personal journey to educational research. Readers who find comfort in statistical numbers and those that subscribe to a
positivist paradigm may have difficulty in evaluating and assessing the findings in this study. A few years ago, I heard a successful mathematics educator make a distinction between interpretive and quantitative research in the following way: interpretive research involves generating hypotheses, while quantitative research involves testing hypotheses. Now that I have fully stated my research perspectives and biases, I say the distinction made was very naive. Of course, there is partial truth in the distinction claimed. But what is more important to remember is that not all educational phenomena (such as mathematics teacher culture) fall within the divide of testing/generating. This dissertation seeks to move beyond that perceived division. Michael Hammersley and Paul Atkinson fitfully summarize my intentions in doing this study: "the search for universal laws is rejected in favor of detailed descriptions of the concrete experience of life within a particular culture and of the social rules or patterns that constitute it" (quoted in Robin Scott and Edward Usher, 1996, p. 143).

I wrote this chapter not only to give a systematic account of what I did or how I played the ethnographic exercise (and perhaps a way to provide footprints, that is, an audit trail). Beyond that, I engaged in a form/mode of problematization about the role of the self in research, addressing epistemological questions along the way. Finally, I emphasize once more that this study operates within a poststructural methodology that anticipates the complexity of the rhizome. If we take "text" to mean "teacher culture," Terry Eagleton's remark makes an interesting endnote:

It is in the significant silences of a text, in its gaps and absences that the very presence of ideology can be most positively felt. It is these silences which the critic must make "speak." The text is, as it were, ideologically
forbidden to say certain things; in trying to tell the truth in his own way, for example, the author finds himself forced to reveal the limits of ideology within which he writes. He is forced to reveal its gaps and silences, what it is unable to articulate. Because a text contains these gaps and silences, it is always incomplete. Far from constituting a rounded, coherent whole, it displays a conflict and contradiction of meanings; and the significance of the work lies in the difference rather than unity between these meanings. (Eagleton, 1976, p. 34)
CHAPTER 4

(RE)READING URBAN MATHEMATICS TEACHER CULTURE

The critical ontology of ourselves has to be considered not, certainly, as a theory, a doctrine, nor even as a permanent body of knowledge that is accumulating; it has to be conceived as an attitude, an ethos, a philosophical life in which the critique of what we are is at one and the same time the historical analysis of the limits that are imposed on us and an experiment with the possibility of going beyond them.

Michel Foucault
What is Enlightenment?

ASIDE: Contradictions/Conflicts and Double Binds --
Deconstructing The Notion of Uniformity in Teachers' Culture

I begin this chapter with a reflective aside, taking feminist-philosopher Judith Butler's notion of Derridean deconstruction as a way to reread the familiar concept of "uniformity" in teacher culture. Following Ann Lieberman and Susan Stodolsky, I argue in this aside that research on teaching and teacher culture has shifted focus from an illusion of uniformity and a generic prescription of good teaching to an approach of changing contexts of teaching that (w)rest(les) comfortably in the rhetorics of diversity and specificity of a teacher's work (Lieberman, 1992, pp. 1-10; Stodolsky, 1988). The factor of diversity in a teacher's work is brought about by the phenomenon of deskilling and intensification of the teaching job (Michael Apple, 1990), and an acknowledgment
that a teacher in the United States deals with the issue of diversity in the classroom. The
factor of specificity of a teacher’s work is highlighted in Stodolsky’s work (1988)
wherein she claims that the teacher-participants in her study teaches in different ways at
different times in different classrooms. I define specificity to include a teacher’s
specialized pedagogical content knowledge (Lee Shulman, 1985) (i.e., specific
content-pedagogy requirements).

Butler (1992) writes, "to deconstruct is not to negate or to dismiss, but to call into
question, and most importantly, to open up a term ... to a usage or redeployment that
previously has not been authorized" (p. 14). Both subject (i.e., disciplinary) and human
relations in schools actively (re)produce contradictions and conflicts or what Gregory
Bateson calls double binds. Double binds refer to two communicative actions that seem
to contradict each other. A damaging effect of double binds is a form of rational
paralysis as a consequence of failing to "discover the conflict" (Bateson, 1973;
themselves both discursively (through enunciated tactics) and nondiscursively (through
unarticulated strategies) in decisions and in actions, and in the mutual presupposition of
intended actions and the unintended effects of the actions.

The first few illustrations that I mention are drawn from the educational generalist
perspective. Sara Freedman, Jane Jackson, and Katherine Boles (1983) have argued that
(public) schools as institutions generate contradictions and deny any possibility for
denouement -- they "create contradictory feelings and demand contradictory actions from
teachers" (p. 263). Some of the contradictions they talk about include:
• Teachers work in an institution which supposedly prepares its clients for adulthood, but which views those entrusted with this task, the teachers themselves, as incapable of mature judgment.

• Education is an institution which holds that questioning and debating, risk and error develop one's thinking ability. But learning situations are structured to lead to one right answer, and both teachers and students are evaluated in ways that emphasize only quantifiable results.

• The schools have the responsibility of developing the whole child. But the structure of the institution constricts the types of behavior acceptable in teachers and students.

• Education is charged with the social task of providing equal opportunity for the school-age population of a pluralistic, multilevel society. But the structure of schools emphasizes comparative worth and increases competition not only among the pupils but also among parents, teachers, and administrators.

• Public education is charged with upholding democracy by developing an electorate capable of critical thinking and the intelligent balancing of alternatives, but teachers are required to pursue this goal by increasingly mechanical, technical means. (Freedman, Jackson, and Boles, 1983, p. 263)

Unexempt from such situational, institutional, and structural realities, mathematics teachers' lives and work environments are always already imbricated in the same politics of ambivalence. For instance, Paul Cobb, Erna Yackel and Terry Wood (1988) have talked about the "paradox of mathematics teaching:" mathematics teachers are asked especially by the constructivist reform movement to encourage their students to use their informal and situated epistemologies and spontaneous knowledges, but at the same time the responsibility of teaching calls for them to deploy sophisticated -- and certainly more valued -- arithmetics of socialization: those "officially sanctioned formal knowledges of codified arithmetic" (p. 93). The problem is confounded when mathematics teachers exercise the taken for granted "correct' view of mathematics."
teacher-participants in this study deploy the socialization and acculturation tactics with
good intentions but are often unaware of the unintended effects of unarticulated practices.
This is taken up fully in Chapter Five.

Mathematics teachers also have to concern themselves with ongoing debates
about individual (intrapersonal) versus social (interpersonal) ways of doing
mathematics. Stieg Mellin-Olsen, for instance, argues that a double bind occurs as a
result of a "contradiction between examination systems calling for individualistic
strategies and the ideology calling for cooperative methods" (Mellin-Olsen, 1991, p. 39).
In general, this issue is related to the problematic of what constitutes effective
communication and learning in mathematics. Along this thread of thought, mathematics
teachers nowadays are encouraged to "de-activitize" whole-class instruction because it is
"necessarily dull and over-used" (Thomas Good and Thomas Biddle, 1988, p. 132) and
explore student group-based instruction because it is "full of potential and under-
utilized" (Ibid.). But how does that recommended practice deal with the social context of
urban teaching in which students are apparently resisting mathematical knowledge, as I
have witnessed firsthand with CHS students? How are all mathematics teachers expected
to employ group work if in CHS, the teacher-participants in this study experience "round
robin student absentees"? Once more, mathematics teachers' beliefs and practices are
caught up in this politics of assimilated contraries.

The nature of school mathematics is itself full of contradictions. School
mathematical knowledge is framed within the binary logic of dehumanization/

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1 To be explained later in section 5.1.
humanization (Peter Taylor, 1996; Richard Noss, 1988). From didactic theoreticians we learn that the decontextualization and depersonalization of mathematical knowledges have processually and transparently transformed knowledges in neat packages -- as found and formal objects. Consequently, the construction of school mathematics has been institutionalized and framed as neutral, context-free, and guided by the "rationalist myth of cold reason" (Taylor, 1996, p. 163). Pedagogical implications include a type of mathematical knowing that is "asocially cognitive" which, once more, is incompatible with current constructivist reform that is emergent.

What practitioners define as relevant in school mathematics is also a source of conflict. Tony Brown (1997) argues that (school) mathematical phenomena "do not have a real existence, there are no referents, and any meaning is derived purely through relations between these phenomena" (p. 63). Also, Peter Taylor insists that:

The relevance of mathematics to the world outside of school is considered to be an *extra-mathematical* issue, and is addressed as an application rather than as a potentially motivating problem-forming and problem-solving context for the genesis of mathematical knowledge. (Taylor, 1996, p. 163)

Taylor's polemic should remind us of the experience Mr. Taft and his colleagues had when they tried to offer a consumer-type mathematics in lieu of the more abstract algebra/geometry course that, based on their experience, many CHS student do not find relevant and useful in their own lives. Mr. Taft has talked about it in the following way:

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3 I am using the word "emergent" based on Cobb's (1997) formulation of emergent constructivism. It is emergent in the sense that mathematical knowing oscillates between individual (and hence, Piagetian) and social (and hence, Vygotskian) dimensions.
We had a class that literally dealt with, you know, you got paid $2.95 an hour and you work 40 hours, how much... do they owe you to pay.... And they [i.e., the math reform panel] finally said, "you can do it. We’re not gonna provide you with textbooks. So you either buy your own textbooks, buy ‘em yourself, or you can actually xerox everything. You gotta make your own materials. ... We ended up not teaching it. (Mr. Taft, First Interview)

Reflecting on Freedman, Jackson, and Boles' list of contradictions vis-a-vis the situation in CHS, two thoughts are noteworthy:

- Ms. Lynch's enthusiasm towards using the computer as part of her instructional plumbings was thwarted by a comment made by Mr. James: "You better stick with what you're supposed to do." Teachers are supposed to develop independent, responsible adults, but they themselves are perceived as lacking independence and judgment. Ms. Lynch says, "We have certain things that we're supposed to teach and that if we vary off of that, then we're not covering their expectations."

- Mathematics teachers are strongly encouraged by the reform movement to develop their students' mathematical power, but the non/pedagogical relationship is embedded in preconditions that are always and already to the subject/discipline and teachers' advantages. Mr. Jack insists that in order for mathematics to be "fun, it is essential that kids know and understand some basics." Mr. Taft's goal is "to have [students] as quiet as possible." School mathematics for Mr. Taft is not about writing essays: "there's no essay," "there's no interpretation." There is just one right answer.

How, then, do we begin to negotiate our understanding of the issue of uniformity in urban mathematics teacher culture vis-a-vis the workplace realities of teachers? Judyth Sachs and Richard Smith (1988) argue that "teacher culture is characterized by
uniformity rather than pluralism" (p. 425). This characterization is based on arguments that John Goodlad and Basil Bernstein presented in 1973 and 1987, respectively. Sachs and Smith (1988) echo Goodlad's perception that schools possess "a certain sameness about them, no matter where they are located" (p. 425). For Bernstein, "educational practices and educational principles exhibit an overwhelmingly and staggering uniformity independent of the dominant ideology" (Sachs and Smith, 1988, p. 425). While there is some truth to both Goodlad and Bernstein's perspectives, I insist that, against uniformity and sameness, a mathematics teacher's work in its multiplexity is wed to a plurality of competing factors and changing -- thus, unstable -- contexts that redound from the various contradictions, conflicts, and double binds that is negotiated with daily in classrooms and the work environment.

In this chapter, I deal with urban mathematics teacher culture, not from the "simple to the complex," but from "the complex to the structure of complexity" (Tony Wilden, 1981, p. 1) of their cultures. Here I also deal with Research Question 1, restated below for convenience.

What does it mean to teach high school mathematics in an urban school at the present time? Specifically: How do mathematics teachers' epistemologies, practices, beliefs, attitudes, and previous mathematical experiences or prior mathematical knowledges act on the way they teach mathematics in the classrooms? What kind of mathematizing do they practice? In what ways do the social context of mathematics teaching and certain conditions of existence impose their limitations on classroom practices and curriculum innovation?
I respond to these questions by dealing with themes that emerge from the ethnographic work. Further, I try to make more sense of the themes by revealing how research studies on teacher culture in the wider terrain of thought\(^4\) address the concerns that teachers in this study have identified as significant.

4.1 The Social Context of Secondary Urban Math Classrooms\(^5\):

**What Makes Mathematics Teaching Difficult?**

This section provides an analysis prefatory to later sections that deal with my rereading of mathematics teachers' knowledges, beliefs and attitudes, and practices from a variety of other theoretical impositions. The analysis here is conservative but is certainly "dangerous:" my analysis allows me to (re)construct my teacher-participants in a particular way within the epistemological tone of this discourse (thus, revealing some of my own unarticulated agenda.) In section 4.2, I talk about how all four teacher-participants' epistemological perspectives tend to influence the way they practice "mathematizing" in their classrooms. I justify my assertions through teachers' personal (early/prior mathematical) experiences and through an illustrative analysis of a few classroom situations where I found them in the actual phase of teaching mathematics. My interpretive analyses show that differences in epistemology translate into differences in pedagogical practices and instruction. Section 4.3 deals with what has been taken as

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\(^4\) As explicated in Chapter Two.

\(^5\) I am taking Paola Sztajn's (1995) challenge that research theorizing in reform and mathematics education must consider the actualities of teachers' everyday work in the classrooms. This way, we avoid constructing "theories that appear more like speculative idealism than concrete realism" (Deborah Britzman, 1986, p. 447).
implicit in section 4.2, that is, the roles of a mathematics teacher's beliefs, attitudes, and practices as they relate to urban mathematics teaching and learning. The summary section (4.4) is a further rereading of mathematics teacher culture in which the focus involves an "interruptive process" because of some plausible "myths" that my participants may be hegemonically employing as a justification to why they do things the way they do.

Alba Thompson (with many others like Paola Sztajn (1995), Shirk (1973), and R. Bawden, S. Burke, and G. Duffy (1979)) insists that issues that relate to (mathematics) teachers' conceptions (encompasses knowledge, beliefs, and practices they deploy in classrooms) do not fall within a simple category of cause-effect analysis (Thompson, 1984, p. 124). Hence, when I talk about in/consistencies between a mathematics teacher's espoused beliefs (i.e., beliefs-in-theory) and enacted beliefs (i.e., beliefs-in-practice), it is significant that I approach it from a rhizomatic perspective. This section provides an introductory analysis in order to widen my understanding (as well as the reader's) of the changing contexts specific to a mathematics teacher's beliefs and practices. Specifically, I analyze the social frame of our teachers' culture -- both the "ethos of teaching" and the "new ethos of schooling" -- that, in fact, has helped me

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6 I thank Margie Sheehy for pushing this "cold, rational idea" at a crucial moment in my research when I thought I was "drowning" in a realist tale, participating in some kind of syndicalist empathy that is emotionally rooted in the way my participants constructed their own culture.

7 Dan Lortie's (1975, p. viii) concept of "ethos of teaching," according to Provenzo, Jr. and McCloskey (1996), deals with "the patterns of orientation and sentiments which is peculiar to teachers and which distinguishes them from other occupations" (p. 1).

8 Following G. Grant (1988), Provenzo, Jr. and McCloskey (1996) claims that a new "climate or ethos" of schooling - "a more inclusive ethos" (p. 10) - has emerged some time in the mid-1960s.
better understand the structure of complexity of their belief systems and pedagogical practices.

4.1.1 The Urban Schooling Phenomenon of Round Robin (Student) Absentees and Possible Implications

All four teacher-participants in this study strongly agree that "poor" student attendance affects what mathematics is taught as well as how they teach it. Ms. Prahst says:

Because the attendance is so sporadic, it beats you up after a while .... It's like you can slow down to a point but then you get stagnant and you don't feel like you're progressing on. ... That's what I feel. I don't feel I am constantly moving on. We cover a topic that should take a day to cover, but it's taken a week. And that's where I feel I am right now. (Ms. Prahst, third interview)

The phenomenon which I call round robin absenteeism makes it extremely difficult to establish continuity and depth in mathematical knowing. Mr. Jack argues that when "you have like a 30% absenteeism right now on a regular basis. And that 30% that are absent may not be the same 30% all the time," it really is difficult to implement change.

which has had an impact on teachers' daily work experiences (p. 3). They characterize the new ethos by the following "factors of change" (p. 10):

the various civil rights struggles, the changing character of work and households, the impact of television, the expansion of higher education, and population shifts, all have in common the inclusion of more persons and more groups in the public determination of values by which society operates. As a result, schools are guided increasingly by values that include more and other than Protestant, White, male versions of society and schooling. (Provenzo, Jr. & McCloskey, 1996, p. 10)

Further, Provenzo, Jr. & McCloskey (1996) insists that the statement above does not imply that the "Protestant, White, male versions" have been fully jettisoned (p. 10). They also claim that those 19th century sociopolitical schooling issues "remain constant: the bureaucratic controls and structures, the feminized nature of the occupation, the local, lay control of the schools, and so on" (p. 11).
am reminded of a similar argument raised by Mr. Taft from the first interview. His argument captures the dilemma very well:

You know it's a virtual impossibility to give it [i.e., mathematics teaching] any kind of continuity when you can have a class of 30 to 35 kids, you have a third or more missing everyday and in five consecutive days, it's not the same third that's missing everyday. ... You have 30 kids on your roster and you see 20. Now, if it were going to be the same 20 five days a week, then right or wrong, you don't worry about the other 10. But it'll be this 20 on Monday. On Tuesday, you still got 20, but three of the kids who were here yesterday are gone, and three of them that were absent are back. And on Wednesday, it will switch a couple more, and on Thursday, it will switch a couple more again.

(Mr. Taft, first interview)

Poor student attendance means mathematics teachers are not able to cover the recommended school mathematics curriculum with the depth that is needed to strengthen conceptual foundations. "It's unfortunate that we can't reach the goals," says Ms. Prahst. Mr. Jack gets to cover about two-thirds of the curriculum because student absentees (and students with behavior problems) "really slow you down." Hence, he thinks that "at the base level," if students "don't learn anything else" in his courses, he prefers his students to "learn and learn well the basic information."

Further, the highly ordered nature of school mathematics vis-a-vis the school's problem with round robin absentees makes it all the more difficult to implement an "algebra or a geometry for everyone." As Mr. Taft argues, "if the kid's not there, you can't." Sessiled to this is time wasted on the necessity of repetition\(^9\): "It's frustrating and

\(^9\) However, she insists that the problem also lies in "time frames." Like if there is a holiday or if it's near the end of classes, her "kids are in and out" of school.

\(^{10}\) "Repetition" here is used differently with the authentic meaning, that is, "repetition" as "an essential requisite of knowing. We know things through characteristics that reoccur - we may choose to assume the most conventional unless we are guided elsewhere" (Tony Brown, 1997, p. 128). The context of Ms. Prahst's "repetition" deals with having to repeat the "same concept"
you find yourself not wanting to repeat but just for the[ir] sake, I better," insists Ms. Prahst.

Poor student attendance also results in the teacher-participants' inability to be flexible in terms of pedagogical innovation and to implement recommendations from the reform movement. Mr. Taft, for instance, has convinced himself long ago that "lecturing" is the best way to deal and cope with the high rate of student absenteees. Consequently, Mr. Taft, like Mr. Jack, does not employ group work. Ms. Lynch still does group work but she notes that students that are habitually absent tend to interrupt classroom discussions, ask more questions, and demand more attention than those who regularly come to school. She says:

(A) lot of students would come to us twice a week. They'll miss three days out of a week and that's not unusual. And they feel they should still be able to get it. And that you should be able to explain in two days, explain what you're really gonna explain in two days in such a way that they can understand it. I mean, they put a lot of responsibility on the teacher while they are off. So some are here Monday and Tuesday. By Friday, you should have explained it well enough that he can understand it. It's your fault if you don't explain it very well. (Ms. Lynch, first interview)

Concerning the implementation of the Standards and the recommendation to apply constructivist principles, Ms. Prahst sees that as a difficult task given the existing circumstance: "Until you start repeating students for failing, that's [i.e., any reform] not gonna work because you have 9th graders with perfect attendance, 9th graders with 50 days absence, 9th graders who don't care."
All four teachers also insist that the present -- as well as the recommended -- school mathematics curricula do not offer the convenience of "extra time" for dealing with such social realities. Time is not a luxury but has become a precious commodity. "I think there's a lot to cover and I think it's difficult to cover even in a rigorous time," says Ms. Lynch.

Although writing within the context of her own work with three elementary female teachers in a public mid-Western school, Paola Sztajn captures the essence of the preceding discussion:

[The] Standards fails to consider the reality of teaching in many ways, especially in its complexity and in the presence of fundamental social and ideological factors that influence what teachers do. (Sztajn, 1995, p. 214)

This study supports Sztajn's view. I am reminded of a comment made by Mr. Jack during our first interview: "The Standards make sense ... there is more emphasis on analysis than on rote learning. ... [But] again those kinds of exercises require time and time is one thing that under the current daily schedules we don't have."

David Labaree (1997) writes that when compulsory attendance was effected in the modern public schools, the "loss of voluntarism" made teaching all the more difficult. Especially for those students that come from the lower socioeconomic stratum, Labaree argues (along many others such as Jay MacLeod (1995), Paul Willis (1977)):

[They] see all around them evidence that the future is precarious and the relevance of education questionable, may calculate quite rationally that the ultimate payoff for academic excellence - getting a good job, securing a comfortable future - is not a realistic prospect for them and therefore does

11"Rigorous time" in the sense that classroom time is not encumbered with too many distractions and disruptions. It is "time" in the normal sense in which a mathematics teacher is concerned mainly with instruction.
not justify a major investment of time and effort in schoolwork. (Labaree, 1997, p. 86)

4.1.2 The Changing Ethos of Schooling Meets the Unchanging Nature of School Mathematics and Mathematical Tasks

James Kaput (1995) insists that while the mathematics education community (teachers, learners, and researchers) is already treading the technological era, the school mathematics curriculum seems to have remained "stable." By "stable," he means the discourse of mathematics in the schools is still tightly located in the power of tradition (of algebra, geometry, etc.)\textsuperscript{12}. In this case, it makes sense to think about the ethos of mathematics teaching as having remained stable, too, but only within the context of a "stable" school mathematics curriculum (i.e., the identities that Schoenfeld talks about) and school mathematical tasks. This stability is personified by the mathematics teacher who, unfortunately, is already caught in "conflicting ethoses."

Mr. Jack believes that students' lack of interest and commitment toward learning mathematics and correspondingly their parents' brookish disposition indicate how they devalue his role in the school.

Parents ... allow the student to take the easy way out in terms of easy courses rather than have them take more difficult courses.

I had a kid a couple of weeks ago who got in trouble second grading period

\textsuperscript{12}1995 Plenary Talk, PME-NA. He identified short- and long-term possibilities in reforming algebra (such as the inclusion of dynamical systems, etc.), in particular.
Mr. Jack perceives student apathy to learning mathematics as resistance to "anything, exposure to life." Student resistance is manifested in many ways: attending math classes without a paper or a pencil on hand; failing to turn in homework assignments and to accomplish worksheet tasks; coming to class late and "with an attitude;" disrupting classroom discussions, and so on. Students, according to Mr. Jack, "didn't receive proper nurturing in the formative years." He thinks parents' views about the significance of education are very important: "education isn't a priority to the parents, so it's not a priority to the kids." Ms. Lynch thinks that student apathy is partly due to students that are in school with little or no desire to learn: they come to class because official agencies require them to show up in school\(^\text{14}\).

Mr. Taft and Ms. Prahsst perceive student apathy in a more different way. Mr. Taft believes that students' lack of involvement is related to the possibility that students "are faced with a lot more challenges today, outside of classroom. ... [and that] (t)hings

\(^{13}\)This is a school that caters to students who have been expelled from "regular" schools.

\(^{14}\)Perhaps we need to distinguish between a student "showing up" and a student "attending" school. A student that attends school means the student understands that s/he is implicated in teaching-learning tasks of the school and the classroom, more specifically. A student that shows up has not committed to any type of productive learning in school and/or in class.
have changed." Ms. Prahst argues similarly: that "life in general is so absorbing. There's so many things that take your energy away ... [and] it's going to get worse because of everything ... in the family structure and everything else."

Thus, the teacher-participants perceive what Provenzo and McCloskey refer to as "disrespect" towards the school as a workplace. One obvious implication of disrespect is the (de)valuing accorded to mathematics by families and the society, in general. Ms. Prahst insists that the "give-up-too-easy" kind of attitude may be a reflection of how our society reacts to difficulties often encountered by an individual in mathematical learning.

Mr. Jack thinks that students, because they are accustomed to "half doing," only undermine themselves in terms of not being able to "measure up to expectations."

They can't accept why "if I do two assignments out of 16, why I shouldn't be getting a decent grade in this course." And they're willing to fight and argue that they're right and you're wrong because they don't understand it. And you have a very difficult time even explaining to them the concept of points and percentages because their math skills are so low that they don't understand percentages. ... Because they're in a culture that has allowed them to just exist.

A comment made by Ms. Walters, counselor for seniors at CHS, is also relevant:

I think our culture allows people to say "I'm really terrible at math" without having a negative stigma attached to that. Adults [say], "Oh, I can't balance my checkbook. I'm really always been terrible at math." And people will think along with them like it's a funny nonskill to have. And I'm not sure where it begins or why we've allowed people to use that as an excuse but we have and that's very sad because people cough out at it by saying, "I'm not good. Therefore, I don't have to be good and therefore, it doesn't matter," and they're really hurting themselves.

Another possible implication of disrespect is concerned with the way mathematics teachers construct their "understanding of what constitutes appropriate
behavior" (Martyn Denscombe, 1980, p. 286) in their classrooms. The

teacher-participants in this study support Denscombe's (1980) claim that "the
characteristics of the clientele are a strong influence on teacher's perceptions of
appropriate activity in classrooms" (p. 287). Ms. Lynch, for instance, is not at all
"happy" with the practice of tracking in CHS. She thinks it is difficult to have all
students that have no intentions whatsoever to pursue college work banded together in
one class. Her activities in this class tend to deal with "superficial" problem processes
that mainly target the mastery of skills and procedures. Similarly, because he believes that
he is working with "extremely apathetic students," Mr. Jack does not do nontextbook
activities nor employ group activities. For instance, he does not deal with actual,
everyday problems and problem solving processes except when the course topic requires
him to do "applications" such as word problem solving in algebra. Also, Mr. Jack says:

Group activity with many of our students is a problem because of their
socialization skills or lack thereof. They don't know how to sit down
and focus on something and be quiet. And they can't work independ­
ently either that well. (Mr. Jack, third interview)

Mr. Taft "lectures" all the time, and does not seem apologetic for not doing a variety of
other activities (except for worksheet-based activities). "It's not there in my classes," he
once said about the need for classroom discussions.

Denscombe's claim that a teacher's activity is influenced by the characteristics of
the classroom clientele has consequential effects on a (high school) student's initiation
and acculturation in a given field of study such as mathematics. If a mathematics teacher
has a "low clientele perception," then the teacher may under-stress a student's
"mathematical power," that is, the student's "ability to explore, conjecture, and reason logically, as well as the ability to use a variety of mathematical methods effectively to solve nonroutine problems" (Curriculum and Evaluation Standards, 1989, p. 5). This "under-stressing" is evident in this study, as I have witnessed firsthand in most of the math classes of Mr. Taft, Mr. Jack, and Ms. Lynch. There was an emphasis on procedures and on what the teachers deemed to be "basic information." Mr. Taft, for instance, would spend a few minutes on definitions and approximately thirty minutes on problem solutions. The two classroom episodes below are typical of Mr. Taft's classroom interactions.

**Episode 1.** (Mr. Taft's (T) Precalculus, December 1, 1997) The class starts with a new chapter (exponential functions).

T: An exponential function is any function f(x) that is written f(x) = a^x.

(*Mr. Taft writes f(x) = a^x.*)

T: This time the variable is the exponent. If it's an exponential function, then the variable happens to be the exponent and will fall into two categories:

(*Mr. Taft writes: (1) exponential growth; (2) exponential decay.*)

T: An exponential growth function is when a > 1. So taking your calculator, if you brought it, I want you to graph the function y = 2^x.

(*Mr. Taft gives them about a minute to accomplish the task.*)

T: You should have something that looks like this:

(*Mr. Taft draws the figure below.*)
T: It's growth, so it's growing up.

Now it's an exponential decay if $0 < a < 1$, like $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{3}$, something like that. So type in $y = \left(\frac{1}{2}\right)^x$ and it should go the other way.

(Mr. Taft draws the figure below.)

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T: Now the first thing you do, the first set of problems deals with powers. If the bases are the same, for example:

(Mr. Taft writes: $5^{2x+1} = 5^{x+1}$)

T: Well both of them have the same base 5, therefore you would say

\[
\begin{align*}
2x + 1 &= 3 - x \\
3x + 1 &= 3 \\
3x &= 2 \\
x &= \frac{2}{3}.
\end{align*}
\]

x is always allowed to be a fraction, it could be negative. To check, we simply put in the value back to x.

(Mr. Taft does it orally.)

T: So some of the problems would look like that. If you have $5x^2$, then you have to resort to the quadratic formula, or hopefully be able to factor. Or you may have something like this:

(Mr. Taft writes: $7^{2x-2} = 49^{x-1}$)

T: Here 49 can be rewritten as $7^2$, and so now we can solve for x.

(Mr. Taft solves the equation.)

T: If you're given this:

(Mr. Taft writes: $(\frac{1}{6})^{3x-1} = 36^{2x+3}$)
T: The only way to solve the problem is to be able to maneuver it so that you have the same base. Now recall our formula:

\[ \frac{1}{6} = \frac{1}{3^x}. \]

So this \( \frac{1}{6} \) is really \( 6^{-1} \), and this 36 is equal to \( 6^2 \).

T: So now we have: \( (6^{-1})^{-1} = (6^2)^{2x+3} \).

(Mr. Taft solves the problem himself.)

T: So basically there are three choices: First: if it starts with the base being the same, we simply equate 1st exponent and 2nd exponent, and solve for the variable. Second: having to change so that you have the same base on both sides. If not possible to maneuver, then the possible cannot be done. Third: there is another scenario than can happen. Suppose, for the sake of argument, we have:

\[ 10^{2x+7} = 10^{2x+11} \]

T: So here we have \( 2x + 7 = 2x + 11 \). So \( 7 = 11 \). My number statement happens to be false. If the number statement is false and there is no variable, thus we conclude there is no solution. So \( \emptyset \). There’s not any number you know that will satisfy \( x \). If you have something like \( 3x - 7 = 3x - 7 \), here you have no variable, and your number statement is true. Then we have \( \mathbb{R} \), all of them would be correct.

So now you can start with page 150. Do numbers 1 through 8.

The seatwork problems are about simple exponential equations with the usual linear exponents (for e.g., \( 7^{x+6} = 7^{3x-4} \), \( 3^{x+2} = 3^{3x+2} \), \( 27^{x+1} = 9^{2x-3} \)). Solutions are mostly conditional, too, that is, there is always an answer. Episode 1 above illustrates how students’ mathematical power is taken for granted. Even if students have with them their graphing calculator, they were not provided with an opportunity to explore and at least reason graphically about the nature and behavior of an exponential function. The main mode of representational analysis to solving exponential equations is symbolic. No alternate ways of solving exponential equations were suggested, especially when they had to deal with some special cases. An alternative analysis is provided in Section 5.2.3.
Episode 2. (Developmental Algebra, December 4, 1997) Students are working on problems involving functions.

T: Okay, page 188. Number 1, “use the completed pairs in the table to find the value of a in y = ax + 1, to fill in the blanks of the table. (a) Find the pair (-1,3) in the table. Substituting these values of x and y into the equation, you get 3 = a(-1) + 1. What is a? (b) Find the pair (2,-3) in the table. Substitute these values of x and y into the equation. What is a? (c) What value do you get for a when you substitute (-2,5) into the equation? (d) Describe how to determine y when you know x. (e) Use the equation to copy and complete the table.”

Okay, first two parts a and b, they’re leading us there. We’re supposed to have 3 = a(-1) + 1, which also means 3 = -a + 1. Take the opposite of 1. So 3 - 1 = -a + 1 - 1. So 2 = a. We need a, not -a, so take the opposite of -a, which is a, and the opposite of 2, which is -2. So a = -2.

(Mr. Taft does the same thing for -3 = a(2) + 1. Then he solves (c), (d), and (e). For (e), he fills the table. Here the class spends 4 minutes doing all five problems.)

T: Number 2.

(Mr. Taft writes y = ax + 20 and the given table of values.)

T: Here if x = 1, then y = a + 20. Now what number a do we need to get 25?

(Students mumble their answer.)

T: 5! Let’s try if x = 2. Then we have y = 2a + 20. What number do we need to get 30? Also 5. Therefore y = 5x + 20. You just have to substitute and figure out what number satisfies the y values.

(Mr. Taft proceeds to solving for y when x = -10, -2, -8, 0.)

T: Number 3. We have y = ax².

(Mr. Taft also copies the table of values and does the same thing.)

T: Number 4. y = -20x + b.

(Mr. Taft copies the table of values and concludes a = 10 and b = -20.)

T: Number 5. We are given: “A juice drink manufacturer makes a drink that is 8% fruit juice. The plant gets 6000 gallons of juice each day. The amount of drink the plant can produce each day is a function of the amount of juice it uses. The domain of the function is: (a) any
number from 0 to 6000; (b) any number from 0 to 48000; (c) any number from 0 to 75000; (d) y = 0.08x."

So the domain is?

(Mr. Taft waits for about half a minute. No response.)

Obviously it's (b) because the plant only gets to use 6000 gallons of juice each day.

T: Number 6. We're given: "Look for a pattern, and complete the table. Write an equation that describes the relationship between the quantities. Then use your equation to find the number of squares that would appear in the tenth figure."

(Mr. Taft copies both the figures and the table of values.)

T: So if we have size 1, we have how many blocks? 1. With size 2, we have? 4. So, with 3, we have 7, and with 4, we have 10, and with 5 we have 13. Now are the numbers consecutive 1, 2, 3?

Jay: Yes.

T: What is 4 - 1?

Jere: 3.

T: Okay, so the number in front of the x is 3.

(Mr. Taft writes 3x in the table of values, as follows:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>...</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>13</td>
<td>3x</td>
<td></td>
</tr>
</tbody>
</table>

T: Then what we have are 1, 4, 7, and 10. So we subtract 2 from 3x. So y = 3x - 2. So the 10th is 28, right?

(Students nod.)

T: Okay, number 7. We have: "A small square table can seat four people. When two tables are pushed together, eight can be seated. Continue the pattern and determine how many people nine tables can seat."

So this is similar to number 6. So 1 table seats 4 people, 2 tables seat 8 people, 3 tables seat?
(Mr. Taft waits for about 5 seconds.)

T: 12. What about 4 tables?

(Mr. Taft waits. Students mumble their answer.)

T: 16. Okay so we have \( y = 4x \). So nine tables can then seat?

(Mr. Taft waits for about 5 seconds. Students mumble "36.")

T: 36. Next number, eight. Here, we are supposed to "complete the following equation for the area of the unshaded part of the figure: \( A = \) _______."

(Mr. Taft draws the figure.)

T: So the area of the shaded region is?

(Mr. Taft waits for about 10 seconds. No response from students.)

T: \( 5(x - 2) \). Now what's the area of the larger rectangle? 8x? Okay, so \( A = 8x - 5(x - 2) \).

(Mr. Taft continues the lecture. Total time for solving 15 problems: 35 minutes.)

In Episode 2 above, Mr. Taft solved fifteen problems that were stated in different representational contexts (symbolic/algebraic, graphical, geometric, etc.). Except for students Jere and Jay whose responses were far from significant, Mr. Taft took for himself the task of exploring, conjecturing and reasoning, and using a variety of methods to solve the different problems.

In one of our interviews, Mr. Taft expresses his disappointment with all three of his Developmental Algebra A classes because he thinks they are not capable of dealing with the "real, hard algebra." His apparent lack of patience ("measured" by his wait time) tends to under-stress his students' capability to perform devolutioning processes\(^{15}\). Also,

\(^{15}\)See p. 124 in this chapter.
a "low clientele perception" for Mr. Taft translates to a classroom interaction that is apparently under (or never) utilized as illustrated in Episodes 1 and 2 above. In fact, students in his classes may have been conveniently initiated and acculturated to the mimetic tradition of learning mathematics in which "knowing" is already anchored in passivity.

Tony Brown writes:

Teaching is not about transferring the teacher's intention. Rather, teaching is more about cultivating the significance the learner gives to the teacher's input, which necessarily entails a reconciliation of personal experience with social coding. (Brown, 1997, p. 97)

The problem, of course, is centered around the "cultivating" aspect of teaching. What happens if mathematics teachers are already predisposed to thinking that their students (supported by parents and the wider society they represent) are disrespectful of the workplace in which "important things are done" (Eugene Provenzo and Gary McCloskey, 1996, p. 101)?

At this point, it makes an interesting case to juxtapose the teacher-participants' views about "student disrespect" with the question "Does the school mathematics curriculum revolve around students' interests and background?" "Low achieving students," Mr. Taft thinks, probably need a different kind of mathematics -- a consumer math type that deals with survival and everyday life. Ms. Lynch is unsure of this; she says she has not thought about it because she views mathematics as dealing mainly with "structures" and "cognitive, formal processes." Elliot Eisner and Elizabeth Vallance

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refer to this abstract, formal view of the curriculum as "academic rationalism" in which students acquire the knowledge that "they do not own and may not own" (Eisner and Vallance cited in Bracha Alpert, 1991, p. 358). Ms. Prahst thinks that the curriculum provides the background information students need to tackle college-level mathematics. Here, Ms. Prahst's view illustrates what G.C. Lewis has referred to as "vicarious prudence" (Lewis, 1849) - a kind of "utilitarian justification" (Bell, 1971, p. 200) in which teachers act with the intention that they know what their students need. She claims that because students have not developed the habit of "thinking ahead [into the future]," so "it's up to us [i.e., teachers] to ... make it relevant to their own lives."

4.1.3 Teachers' Isolation in the Mathematics Classrooms

The phenomenon of isolation or privatism has been widely documented in research studies on teacher culture. A crucial aspect of a teacher's socialization and (in a way) an indirect test of competent membership in the teaching profession, privatism "forces" the teacher to be independent and to take control of the classroom, that is, provide a "space" that is conducive for teaching and learning. Dan Lortie claims that privatism or a teacher's sense of isolation is not about a teacher's desire for personal and professional autonomy, but is the "product of the formal organization of the school" (Lortie cited in Denscombe, 1980, p. 287). Schools, according to Denscombe (1980), operate within a "closed classroom" system in which teachers are encouraged to be "self-contained," and to "innovate and use ad hoc procedures" especially when immersed in new circumstances that "deviate" from the usual, standard situations (p. 288). A
statement made by Ms. Prahst clearly exemplifies this ethos of individualism: "(W)e're all just these little sattelites out here doing our own thing."

What conditions privatism and how may these conditions affect mathematics teaching? First, teachers are not encouraged to "get together" and meet as a department to set goals, visions, and plan for students' needs. (Although, certainly they work within a structured set of goals and objectives.)

Mr. Jack: The only thing that we've had now have been the meeting at the beginning of this school year and the meeting at the end of [last] schoolyear to determine what classes various teachers were to teach.

Ms. Lynch: I don't even remember the beginning of the year.

Mr. Jack: I don't neither, really.

Ms. Prahst: It's kinda a shame that you don't see people talking more often and getting together to find out what our beliefs are or that we are meeting the needs. It's good that we have freedom to do whatever but what it sounds like, there really needs to be a dialogue going on between teachers.

Acquiring a disposition towards isolationism becomes the only option because teachers have no obligation to work as a team: "Our contract says we are to stay until 2:45 and in the 15 minutes that we are required to stay, it's just kinda like pack up and leave," says Ms. Prahst.

Both Ms. Lynch and Mr. Jack feel the impact of isolation especially when they have to deal with "deviant" cases and difficult situations on their own.

Ms. Lynch: If all the teachers have a focus on the way we do certain things so that when they go from class to class, there'll be some unity
and consistency. ... If we have unity and just pick a few things that these are the goals, what an accomplishment that would be. ... Just think how much more powerful if all the teachers have a consistent way of dealing with certain things, how much better.

Mr. Jack: Maybe if there were consistent techniques used from classroom to classroom, students would know what the expectation is, and as a consistent expectation, we wouldn't have struggles in terms of bearing consequences for various behavioral offenses.

Second, having a class schedule that requires a teacher to move constantly from one room to the next -- that is, be all over the building -- may prevent collaboration from occurring. "I feel a lot more isolated this year than in years past," argues Mr. Jack, because his daily schedule takes him to different places in the building at different times (i.e., class periods). He says, "I can go for almost three days without seeing Ms. Prahst."

Third, moving beyond the teacher-participants' problems with the staff and the department, lack of support and collaboration from parents and from the immediate society condition individualism and isolation, especially because mathematics teachers deploy a subject that, according to Ms. Lynch, has historically "had a bad reputation." Mr. Jack is very vocal about his "frustrations" with parents because they seem to fail in "provid(ing) their kids proper nurturing." This lack of collaboration from parents is subtly illustrated by a comment made by Mr. Jack when shared his experience with a parent who had a kid finish mathematics in 1-Pass. Mr. Jack said, "the parent accommodates the kid and he's an educational mess." For Mr. Jack, parents do not seem to support the manner by which teachers educate their children. Ms. Prahst, too,

17See p. 100.
expresses this isolation when she insists that students nowadays are "accepting of bad grades" and although unsure, may be "a reflection of society." In other words, mathematics teachers have to deal with the "give-up-too-easy" attitude of their students themselves because society, instead of providing support to what teachers do, prefer to help students "take the easy way out if it's too hard" and "do something else."

Fourth, I think that the teacher-participants' feelings of isolation (with implications to a teacher's sense of individualism) explain why they (except perhaps for Ms. Prahst in this case) seem to be so "textbook-driven." Because the teacher-participants neither hold departmental meetings to do revisioning and changes in course syllabi nor engage in peer collaboration or "group teaching," isolation both conditions and supports teachers to simply rely on their texts as their only source of information.

4.2 (Re)Reading Mathematics Teachers' Knowledge

Deborah Ball (1988) claims that a prospective mathematics teacher's plumbings include a "host of ideas and ways of thinking and feeling related to math and the teaching of math, drawn largely from their personal experiences of schooling" (p. 40). While some teachers may have acquired a rich history of (personal) experiences, there are those whose prior experiences may have been impoverished or caused them to develop narrow views. Moreover, a teacher's epistemological development may have been caused by the deployment of particular modes of knowing (such as relational, impersonal, contextual). In section 4.2.1, I deal with Ms. Lynch and how I perceive her personal experiences as "impoverished." In section 4.2.2, I deal with Mr. Taft and his narrow experiential
epistemology. In section 4.2.3, I deal with what I refer to as the gendered nature of mathematics teaching, and use Ms. Prahst’s and Mr. Jack’s ways of mathematizing in their respective classrooms to illustrate the distinction being claimed.

4.2.1 Issue with Ms. Lynch: The Poverty of Early Mathematical Experiences

Ms. Lynch's undergraduate degree was in home economics education. A few years after receiving it, she obtained her certification in mathematics. Her mathematical content is typical of any mathematics education major at the time: she had two calculus courses, algebra, geometry, and the history of mathematics. When asked the question "How were your early mathematical experiences?" she replied that in high school, her student-experiences in the mathematics classroom were anchored in discipline and control. She says, "we knew by th[at] time what classroom behavior would entail." In college, she claimed that when her trigonometry instructor took the responsibility of providing the class with formulas they would need to solve problems -- "he didn't make us memorize all" of it -- that experience "was totally new" to her and hence she thought that was "fun."

Ms. Lynch's early mathematical experiences say much about the performative aspect of mathematics as well as the quality of mathematizing that occurs in her math classrooms. Ms. Lynch's early mathematical experiences tend to point to the possibility of a "poverty of interesting mathematical experiences." The two interview excerpts

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18 Of course, I realize the limitation of my knowing because Ms. Lynch did not fully disclose her early mathematical experiences. My question about early mathematical experiences was targeted at meaningful or the most significant experiences.
below further illustrate the argument. First, when asked about how she can make mathematics relevant to her students, Ms. Lynch says:

I can't think of situations in math, I guess. ... Except perhaps shopping and sales tax and that type of thing. But they [students] don't worry about that too much 'coz when they ring it up, the tax is already automatically calculated ... and I don't think they think too much in advance what the tax should be and how much that would be added on to their bill. (Ms. Lynch, first interview)

Second, her notion of what constitutes problem solving deals mainly with formulas and consumer math type of problems (probably owing from her background in home economics) such as "perimeter of a room, and shopping, sale price, going out to dinner going out somewhere where adult tickets might be one price and another price, or ordering t-shirts .. or even telephone bills." Other justification for this "poverty" includes the kind of worksheet activities she employs in class (see Appendix H). Ms. Lynch has been consistently employing problem applications that involve practical consumer-type problems and basic perimeter, area, and volume of geometric figures 19.

4.2.2 The Problem With a Narrow Experiential Epistemology

Mr. Taft originally wanted to be a history teacher. When his interest in history waned, he pursued mathematics as a second option. His mathematical content background is similar to that of Ms. Lynch but more extended: he had four calculus courses, algebra, geometry, and differential equations. Based on the interviews, Mr. Taft's personal experience as a student in the mathematics classroom can be summarized in a few words: that math is math, that is, "basically, it's objective, it's not subjective," he

19 At least during the ten-week study, Ms. Lynch has not deviated from those two application areas.
says repeatedly about mathematics in two interviews. He also thinks that there was not much "original thought in the math classes" he took. That the only difference he saw dealt with the nature of the problems he was asked to solve: "they were tough, very rigorous, and much more rigorous than what we give to the kids nowadays." Further, the way he learned math, which he thinks is the way he teaches mathematics presently, was through lecture and whole-class directed instruction. Mathematics for him has always been "perfect" and "concrete, it's there, here's the procedure; if you follow the steps, you come up with a solution. There's no interpretation."

Like Ms. Lynch, Mr. Taft expresses openly a strong desire to control the classroom: "My goal is to have them as quiet as possible." Silence, for him, is a precondition for any meaningful epistemic encounter. Unlike Ms. Lynch who still employs group work, he thinks group work can only "lead to increase in noise level." There is hardly any discussion in his classrooms: "it might be the way I learned it," he argues. Again, owing to his previous mathematical experience with efficient "lecturers," he sees no need for students to think creatively about mathematics: "That's them versus me. They don't really have to think too deeply to be able to do the work." Mr. Taft's personal epistemology is anchored in an "all objective, not subjective" and context-free mathematics. School mathematics for him has a stable reality and is strongly deterministic.

At this point, it probably makes sense to ask: Where is Mr. Taft's "desire for control" and convenient objectivism coming from? One possible answer is in his perception of the nature of mathematics. Alan Bishop (1991) writes about the ideational
value of control that one derives from Western mathematics. The value of control lies in the security one derives when describing a phenomenon mathematically. "(G)etting the answer 'right'" or the "mathematical valuing of 'right' answers" and perceiving mathematical facts as objective, systematic and logical, and derived straight from rules implicitly illustrate the control dimension (pp. 202-203). While this value is significant and peculiar to the metaphysical framework of mathematics, there is danger when the narrowness of personal experience commingles with this dimension. In Mr. Taft's case, this has led him to deemphasize the importance of multiple interpretations and various representations. "There's no essay," he confidently insists. Further, Mr. Taft says:

The student doesn't have to interpret what my question is in order to be able to do it. ... I guess I'm one of those people who like things to be perfect and math is that ... to me, it's not .. it doesn't have a lot of areas that are open to interpretation. You can't ... there might be more than one way to solve an equation but basically you're still solving the equation. (Mr. Taft, second interview)

4.2.3 Impersonal, Relational, and Contextual Modes of Knowing:

The Gendered Teaching of Mathematics

Marcia Baxter Magolda's (1995) seven-year longitudinal study of male and female college students' epistemological development may provide a more significant understanding of the nature of (teachers') personal epistemologies and how teaching may influence a student's epistemological development (see P. Palmer, 1990, 1987). Baxter Magolda's findings, I must add, appear consistent with gender studies that deal with issues of women's ways of knowing (see Mary Field Belenky, Blythe McVicken Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule, 1986).
Based mostly on qualitative data, Baxter Magolda (1995) claims that female college students tend to employ relational knowing while male college students exhibit impersonal knowing. Furthermore, in post-college years, a significant fraction of the male and female individuals who participated early in her study tend to exhibit contextual knowing; that is, they integrate relational and impersonal modes of knowing. Relational knowers are more "receiving, interpersonal, and interindividual" than impersonal knowers who prefer "mastery, impersonal, and individual" modes of knowing.

The last statement above needs explanatory unpacking. Within the domain of absolute knowing -- in which knowledge is certain-- females tend to exhibit a "receiving" pattern, that is, they prefer to "listen," "record information," "rely on an authority for answers," and "rely on peers only for making the learning environment more supportive" (Baxter Magolda, 1995, p. 207). Males, on the other hand, tend to exhibit a mastery pattern, that is, they rely on authority for answers but tend to "view their own and their peers' involvement as a useful tool to master [a given] material" (Ibid.). Within the domain of transitional knowing -- in which some knowledge is uncertain and needs more thinking than memorizing -- females prefer interpersonal ways of negotiating meaning(s) of uncertain knowledges. Male college students, on the other hand, like the classroom negotiation of meanings but tend to be impersonal about the process. They tend to use the occasion mainly as an instrumental aid in thinking and focusing more about "uncertain" ideas individually. Within the domain of independent knowing -- in which knowledge is uncertain -- females come to know through an interindividual process
(playing the field of others' thoughts in order to formulate their own thoughts) while males tend to cleave to their own -- thus individual -- perspectives (Ibid., pp. 207-208).

While recognizing the problems of labeling individuals based on group characteristics, it is useful to note that the teacher-participants in this study operate in ways consistent with these findings. Both Ms. Prahst and Ms. Lynch are more relational than impersonal knowers while both Mr. Jack and Mr. Taft are more impersonal than relational knowers. Further, they manifest their modes of knowing by the way they teach mathematics. Ms. Prahst, for instance, models a good and "caring" mathematics teacher who seems to foster and value relational knowing significantly. Mr. Taft, on the other hand, seems very efficient in his trade as a "lecturer" but exhibits a type of impersonal knowing that promotes individualistic (highly independent) thinking.

Maxine Greene (1988) refers to teachers such as Ms. Prahst as "individuals in their we-relations with others, inserting themselves in the world by means of projects" (quoted in Provenzo and McCloskey, 1996, p. 25; see Greene, 1988, p. 134). In one of her interviews, Ms. Prahst makes a distinction between three kinds of mathematics teachers which she had when she was a student of mathematics many years back: a real teacher, a theorist, and a college teacher. A real teacher in Ms. Prahst's case is likened to an inspiring high school teacher who can explain concepts effectively. Although her student-mathematical experiences with the theorist and the college teacher were fine, Ms. Prahst thought the real teacher inspired her to "keep going on." As a relational knower, Ms. Prahst acknowledges the importance of having good mathematics teachers that "reach out" and "can explain." She sees much value in being able to explain a concept
successfully in order to inspire students to learn more and appreciate mathematics. She therefore uses various group and individual activities in order to make mathematics appear more relevant and interesting. "They should be given more opportunity to explore," Ms. Prahst insists. Negotiation of mathematical meanings through an interactive dialogue format is, for her, a very important pedagogical strategy. She thinks that it is important to engage students actively in their understanding of mathematical content and to provide a supportive environment in which students are allowed "to answer."

A relational mode of knowing, writes Baxter Magolda, is "characterized by attachment and connection" (Baxter Magolda, 1995, p. 207); it is a type of "connected, subjective mode of knowing" (Ibid., p. 205) in which knower and known are interlocked so tightly that the quality and meaningfulness of knowing, while interpersonally situated, occur in a deep, intrapersonal level. In Robert Young's (1992) work on teacher epistemology, he also speaks of this type of knowing as "a commitment or claim, not something separate from the feelings of the knower, but a way of feeling in its own right" (p. 24). "Clue in to your students," says Ms. Prahst.

Meet them where they are, don't ever put them down. ... Pretend like you're just reviewing it rather than teaching it for the first time. ... Just be honest with them. Try to come down to their level. ... If you use book tests, try to customize them for yourself. Personalize it. (Ms. Prahst, second interview)

Ms. Prahst practices what Greene (1988) has referred to as connected teaching in which "knowledge situations" occur as a result of co-construction between teacher and learner:

Rather than posing dilemmas to students or presenting models of expertise, the caring teacher tries to look through students' eyes, to struggle with them
as subjects in search of their own projects, their own ways of making sense of the world. (Greene, 1988, p. 20)

The classroom episode below illustrates how Ms. Prahst encourages relational knowing.

**Episode 3.** (Ms. Prahst's (P) Geometry class, November 19, 1997) Each student gets a small rectangular cardboard and a pair of scissors.

P: Please draw the largest triangle you can make from the cardboard and then cut it out. It'll be exciting if you avoid right triangles. You'll see later why.

*(Ms. Prahst gives them two minutes to accomplish the task.)*

P: So how many corners does a triangle have?

Ss: 3.

P: Now label each corner with corner 1, corner 2, corner 3.

*(Ms. Prahst gives them about 10 seconds to label their triangles.)*

P: Now you should have each a piece of paper. About 2/3 of the way down, draw a line across it.

*(Ms. Prahst illustrates on the board what she means. See figure below.)*

So everybody should have two things: a triangle and a paper with 2/3 of a line drawn in the paper.

*(Ms. Prahst gives them about 3 minutes to complete the task.)*

P: Next step: Please trace the triangle you have around it.

*(Ms. Prahst again illustrates what she means. See figure below.)*
Now turn around the triangle and you form something like a parallelogram.

(See figure below.)

Now continue turning all the way down, like the one I have here:

Please make a total of 3 rows by sliding the triangle.

(Ms. Prahst illustrates the sliding process and gives her students about 10 minutes that include labeling each triangle that is formed. See figure below.)

P: So do you see a parallelogram?

Ss: Yes.

P: What other shapes do you see?

John: Rhombus.

Amy: Diamond.

Nina: Hexagons.

Pete: Depends on person-to-person.

P: Okay, so what else do you see?

Pete: Trapezoids.
P: Any other geometric figures? What about lines? angles?

Don: We have parallel lines. We have vertical lines, too.

(Don names some of them.)

P: Okay, what about the sum of the angles in any triangle?

Amy: It's 180 degrees.

P: Good, now let's see what happens when I tear off angle 1, angle 2, and angle 3. I want you to do the same thing with your cardboard.

(Ms. Prahst gives them about a minute to complete the task.)

P: Now let's see what happens when we line 'em up, like this.

(See figure below.)

What do you say about the angle formed by this line?

(Ms. Prahst draws an angle marker, as shown.

Ss: It's 180 degrees.

P: Now let's consider the hexagon we have down here.

(See figure below.)

P: Now let's see what happens when we add all the angles together.
We have $2 + 3, 1 + 2, 3 + 1, 2 + 3, 1 + 2,$ and $3 + 1$. What do you observe?

**Ben:** We have 4 3's, 4 2's, and 4 1's.

**P:** Alright. So we have $4(\text{angle } 3 + \text{angle } 2 + \text{angle } 1)$. But what is angle 1 + angle 2 + angle 3?

**Ben:** 180 degrees.

**P:** So $4(180 \text{ degrees})$ gives us 720 degrees.

**Ben:** So the angles in a hexagon add up to 720 degrees.

(Then the class explores the angle sum of a parallelogram and the Exterior Angle Theorem first visually and then numerically.)

The episode above is typical of Ms. Prabst's style of mathematizing. It illustrates relational knowing in which the knower (student) and the object of knowing (known) are simultaneously performing, that is, the knowers are actively negotiating their meanings of mathematical concepts. Or as Young nicely puts it, their mode of knowing is a "way of feeling" for them. One important characteristic of relational knowing is that it allows for devolution to occur which, consequently, transforms learners from "mere students" to "epistemic subjects." Didactic theorists use the term devolution to refer to situations in which students are allowed to take ownership and be responsible for the solution/s of a given problem under discussion.

Another aspect in the analysis of interactions in the mathematics classrooms deals with the nature of talk between teacher and student around some topic. In *Teaching Mathematics: A Sound Alternative*, author Brent Davis (1996) makes a useful distinction between conversation and discussion. The distinction made is not based "in the words spoken or in the topics addressed [but] in the manner in which the participants listen to
one another" (p. 39). Conversation, Davis (1996) says, "is a place of listening" (p. 40) and "the merging of subjectivities" (p. 39) while discussion "is an analytical rhetorical structure" (p. 39). The talk that transpired between Ms. Prahst and her students in Episode 3 above illustrates a conversation in which each conversant seems to have "set aside [his/her] illusions of subjectivity," and makes possible the emergence of a "collective consciousness" about the topic (Davis, 1996, p. 41). There is "relational unity" set within a "hermeneutic thrust" of mutual understanding.

Mr. Jack and Mr. Taft tend to be more impersonal than relational. Impersonal knowers exhibit "autonomous, objective, and rational mode of knowing" (Baxter Magolda, 1995, p. 205). Baxter Magolda (1995) echoes Palmer's claim that educators who are oriented towards this epistemological approach tend to "distance students from knowing and hinder their use of the relational mode" (p. 215). Further, impersonal knowers perceive themselves as "separate" from the objects being known, which appears incompatible with constructivist epistemologies.

We have seen something about Mr. Taft's epistemological perspectives earlier in this chapter. Here we focus our attention on Mr. Jack. Among all the four teacher-participants in this study, Mr. Jack has had the "most" training in both science and mathematics. He earned a degree in physics, with minors in mathematics and industrial technology. Process for Mr. Jack means having an ability to "approach," "attack," and "plan" solutions. Teaching mathematics means "transfer(ring) knowledge [at least] the way I was taught."

²See also Episode 17 in Chapter Five.
So how was he taught mathematics? Like Mr. Taft, Mr. Jack has a "context-free understanding of learning or, at least, an impoverished notion of context" (Young, 1992, p. 22). For instance, when asked if he sees the need for a different approach to mathematics pedagogy, Mr. Jack answered: "No. ... (M)ath is math! I don't see any need to make any kind of adjustment for culture, for cultural differences." Mr. Jack’s classrooms, or at least the epistemic encounters and interactions he exhibits in class, typify what Young has referred to as method classrooms, that is, knowledge is seen as a surefire product of ‘correct' rituals of the scientific method. The common-sense ideas of pupils are simply pushed aside. They aren’t even there. (Young, 1992, p. 22)

The four classroom episodes in the following pages illustrate the preceding argument.

Episode 4. (Developmental Algebra, December 1, 1997). Students are still working on transforming equations having variables on two sides of given equations.

J: The example given on the book is $4y = y + 12$. Mike, what’s the variable on the left side of the equation?

Mike: 4 and y.

J: Val, what’s the variable on the right side of the equation?

Val: y and 12.

J: 12 is not, it's a constant. So how do I transfer a variable on one side?

Val: Add.

J: What do I add? Ultimately what I want to do is isolate the variable on one side.

Jerry: Subtract.

J: Subtract what?

Rina: 12.
J: No.

Blake: 4.

J: No.

Juma: y.

J: The goal is to balance the equation. Make one side contain the variable and the other side the constant.

(They completely solve the equation. Then students solve another equation: 5(1 - x) + 8x = 3(x + 2).)

J: Okay, let's simplify the ones in quantity first. 5(1 - x) means 5 - 5x.

3(x + 2) = 3x + 6.

So now we got 5 - 5x + 8x = 3x + 6. So 5 + 3x = 3x + 6.

I wonder if I wrote this problem right?

(Mr. Jack checks his solution again.) How do I do this?

(Mr. Jack reads the book. Actually, the problem is an illustrated example.)

Okay so they gave us a trick problem. There's no solution here. Okay, so that's a bad problem21.

(Mr. Jack does a similar problem: x + 5 = 1 + x.)

J: So x + 5 = 1 + x. So we add -x on both sides.

\[
\begin{align*}
x + 5 &= 1 + x \\
-x &= -x \\
\hline
5 &= 1
\end{align*}
\]

Again, this doesn't make sense. So we just put no root. So no solution.

---

21 In a later interview, I asked Mr. Jack why he labeled this particular equation a "bad problem." He claimed that such type of problems - "with a wrinkle in it" - would only make the introduction to solving linear equations difficult. For starters, students need more straightforward problems than special cases in which the focus is the mastery of the skills and the correct application of relevant equality rules: "I'd rather not for them to do [such problems with wrinkles] until they have a firm grasp of some of the more basic problems" (Field notes, December 3, 1997)
**Episode 5.** (Developmental Algebra, December 12, 1997). Mr. Jack gives the following equation for students to solve: \( 18 + -8p = -30 \).

Mr. Jack illustrates how to solve the problem, as follows:

\[
18 + -8p = -30 \\
-18 - 8p = -18 \quad \text{do: } \times -8, \text{ add } 18 \\
\underline{\text{undo: } / -8, \text{ subtract } 18} \\
-8p = -48 \\
p = 6.
\]

\[J: \text{ The big secret is just following the process. And that's what we've been doing thus far. And write things out.} \]

**Episode 6.** (Developmental Algebra, January 14, 1998). Students are given the following equation to solve: \( 5x - (x + 3) = 5 \).

\[J: \text{ Now here, you always do the addition first. You've got to drill that in!} \]

**Episode 7.** (Mr. Jack's (J) Developmental Algebra class, January 21, 1998)

(Student are in the process of solving the following problem: Find 4 consecutive integers above whose sum is 116. Mr. Jack leads his students to the following equation:

\[s + (s + 2) + (s + 4) + (s + 6) = 116.\]

\[J: \text{ Okay, so now we have } 4s + 12 = 116. \text{ What are we gonna do next?} \]

(Mr. Jack gives the students less than a minute to think about the next step.)

\[J: \text{ We do what is told us to do. Remember the Ten Commandments? So we "do - multiply 4, add 12 and undo - divide by 4 and subtract 12."} \]

(Mr. Jack solves the equation himself, using the "do and undo" method.)

\[
4s + 12 = 116 \\
\underline{-12} \\
4s = 102 \\
\underline{4} \\
s = 26
\]

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Now we prove if our answer makes sense: So \( s = 26, s + 2 = 28, s + 4 = 30, \) and \( s + 6 = 32. \) So \( 26 + 28 + 30 + 32 = 116. \) If you follow God’s law, you get to heaven.

The four situations above illustrate a type of mathematizing that seems to exhibit impersonal knowing: devolution is taken for granted, the object being known (e.g., solving a linear equation) is perceived as "external" to the knower (the student) her/himself, and process is "other people's process." Students develop the impression that "mathematics" are other people's thoughts that are imposed on them (which partly explains students' resistance to mathematics). This claim is best illustrated by the following statement made by La Shonda on several occasions: "Is this the way Mr. Jack wants us to do this?" What students acquire, then, are skills and processes that don't "really" matter much because the skills and processes have little or no meaning to them at all: "(I)t is what the book says; what the teacher says" (Young, 1992, p. 23).

Contextual knowers tend to balance impersonal and relational modes of knowing. But my own experiences -- through the classroom observations -- with all four teacher-participants in this study indicate they tend to position themselves closer to either pole, at least based on the consistency of their "practice of mathematizing" in the classrooms. Moreover, what I found significant in my analysis of their epistemologies dealt with the following three points:

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21La Shonda (pseudonym) is an African American female student in Mr. Jack's Developmental Algebra class. I would often find myself seated behind her and, on several occasions, helped her work out some homework or seatwork/worksheet problems.
Relational knowing becomes counterproductive to teaching and learning, especially if a teacher "applies" it with a less than sufficient amount of good mathematical experiences. The co-construction of knowledge becomes too difficult to handle for both teacher and student, and the "coming to know" or the "knowing" dimension becomes chaotic, trivial, and meaningless. This observational analysis is based on my experiences with Ms. Lynch in most of her mathematics classes. Episode 8 below illustrates this observation.

**Episode 8.** (Ms. Lynch's Algebra 1 Class, October 31, 1997). Students start exploring the different equivalent processes in solving a linear equation.

(Ms. Lynch writes on the board: \( x - 3 = 8 \).)

L: Additive inverse. What does it mean?

(Students appear confused. No response.)

L: Additive inverse is a vocabulary phrase that should be in your notebook!

(Ms. Lynch points to two differently-coloured tiles.)

L: Remember the adding and subtracting to get 0?

Dan: Yah. The add and minus of tiles?

L: Okay, so what's the additive inverse of 3?

Dan: -3.

L: Okay, so write this down in your notes:

(Ms. Lynch writes on the board: \( x - 3 + 3 = 8 + 3 \).)

L: Remember in your tiles what you do with -3 + 3?

Nitz: Take 'em away, Ms. Lynch?

L: Take 'em away.

(Ms. Lynch crosses -3 and 3 from the equation and writes \( x = 11 \).)
Lyle: Hey, Ms. Lynch, why did you add 3 and -3?

L: Try to remember what we did with the tiles, Lyle.

Jamie: 'Coz you have to, Lyle.

(Ms. Lynch writes on the board: \( x = 6 = 20 \).)

Jamie: Okay, see there we add -6. That's \( x + 6 - 6 = 20 - 6 \), Ms. Lynch.

L: So why did we add -6?

Ben: 'Coz one's positive and the other one's negative.

L: Because adding and subtracting 6 gives 0, right?

Ben: Ms. Lynch, this is confusing.

L: Okay, what are the two other operations?

(Ms. Lynch writes on the board: \( \frac{x}{6} = 7 \).)

L: So what's the inverse here?

Jenny: Ms. Lynch, do we multiply by reversing?

L: Okay so in this case \( \frac{x}{6} = 7 \), we multiply by 6. So that's

(Ms. Lynch writes on the board: \( \frac{6}{1} \times \frac{x}{6} = 7 \times \frac{6}{1} \))

\[ \frac{6}{1} \times \frac{x}{6} = 7 \times \frac{6}{1} \]

\[ x = 42 \]

Gray: I don't think I get it, Ms. Lynch.

L: You didn't get this one?

Gray: I don't know.

L: Okay, let's do another one.

(Ms. Lynch writes on the board: \( \frac{x}{3} = 7 \).)

L: So, look, we multiply by 3.
**Ms. Lynch writes on the board:**

\[3 \times \frac{5}{3} = 7 \times 3\]

\[x = 21\]

**(Next, Ms. Lynch writes on the board):** \[-\frac{2}{3}m = 10.\]

**L:** This one's more difficult. Here you just don't multiply by 3. The book does not tell you this. So what's the inverse of \(-2/3\)?

**Jenny:** 3/2.

**L:** Okay, we could divide both sides by \(-2/3\), but what would I get if I multiply by \(-3/2\)?

**(Ms. Lynch writes on the board):**

\[-\frac{2}{3} (\frac{-2}{3}m = 10) -\frac{3}{2}\]

\[m = -\frac{30}{2}\]

\[m = -15\]

**Carl:** Ms. Lynch, I don't get it. Can I just do a short cut?

**(Carl goes to the board and shows Ms. Lynch how he likes to solve it.)**

**Carl:** Ms. Lynch, I can multiply by 3 and divide by -2. Is that right?

**(Ms. Lynch does not respond. She asks Carl to sit down.)**

**L:** Try this process, Carl.

**(Students are then asked to accomplish a worksheet.)**

- The narrowness of a mathematics teacher's personal epistemologies and personal experiences which s/he then implicitly translates in pedagogic form as a type of impersonal knowing is also counterproductive. Both Mr. Jack and Mr. Taft's deployment of impersonal knowing make it difficult to provide meaningful, alternative routes in mathematical knowledge acquisition. Teaching mathematics
becomes a method of transferring knowledge in which the component "individual and social interaction" is unceremoniously taken for granted.

- Lecturing as the only mode of teaching promotes impersonal knowing and tends to model a kind of individualistic thinking. Provenzo and McCloskey claim that teachers who are mainly concerned with their subject matter -- that is, competent, confident, and interested primarily in "bringing the subject matter to the student" (Provenzo and McCloskey, 1996, p. 33) -- are "individualistic as a result of the personal strength drawn from their knowledge of subject matter" (Ibid.). Mr. Taft does not excuse himself from using lecture which, for a fact, he has been employing since the first day he taught some thirty years ago.

4.3 (Re)Reading Mathematics Teachers' Beliefs, Attitudes, and Practices:

Dealing With Espoused Theories and Theories-in-Use

4.3.1 Ms. Lynch. Ms. Lynch's view of the nature of mathematics is typical and seems to be her only primary-central belief. This belief is consistent with the kind of mathematical content she uses in her mathematics classes. For her, mathematics encompasses computations, procedures, and problem solving. Problem solving involves the usual application of formulas to daily life and the use of consumer mathematics-type problems so as to make the context of mathematizing more realistic. For instance, she uses problems that deal with perimeter, areas, and volumes in her discussion of applications that deal with operations of algebraic expressions. What I find interesting about my analysis of her beliefs is stated below:

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23See section 2.5 on teachers’ beliefs.

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It appears that her espoused and enacted theories and beliefs are not "significantly" drawn from her view of mathematics. Moreover, the social context of teaching has, in fact, made possible the construction of her espoused model of teaching and learning so that it appears consistent with her enacted model of learning and teaching mathematics.

Hence, even if her beliefs about the nature of mathematics appear primary and central and directly influence mathematical content, it does not necessarily mean that her practice is typical and traditional, too (because she often tries new things such as hands-on and group-based activities). So, against Ernest's model (see Figure 2.2), Ms. Lynch's belief model is something more like Model 4.1 below.

![Overall Epistemological Perspective](image)

**Model 4.1 Ms. Lynch's Beliefs Model**

In his model, Ernest asserts that a mathematics teacher's model of teaching and learning is influenced *solely* by the teacher's view of the nature of mathematics. Further, Ernest seems to suggest that the social factor serves as the "mediating difference" between espoused and enacted theories and beliefs. A "big" difference implies inconsistencies while a "small" difference implies consistencies\(^\text{24}\). With Ms. Lynch, the situation seems

\(^\text{24}\)Of course, if a teacher's beliefs and theories are consistent, then it does not follow that her/his beliefs and theories are necessarily "correct." For instance, if a teacher espouses the belief that
different. Ms. Lynch's beliefs -- mostly peripheral -- are rooted in the social context of teaching which then influence her espoused-enacted models of teaching and learning mathematics. Consider the following statements below:

<table>
<thead>
<tr>
<th>Social Context of Teaching</th>
<th>Espoused-Enacted Theories and Belief</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;[I need to] survive.&quot;</td>
<td>Mathematics teaching changes year to year.</td>
</tr>
</tbody>
</table>

"Students think that I should be able to say something clever that would make them understand it just like that."

"Learning is an active thing." To teach mathematics means to be "a guide. A guide, not someone that can say the magic words and you'll just suddenly understand."

[Enacted: Directed instruction, worksheet activities]

"A large number of students are really turned off at math, and were convinced that somewhere along the way that math is for weirdos and smart people only, and that they don't understand it and they'll never understand it. They'll never try. ... Don't even waste your time and they'll take it on me."

Teaching math means finding ways to deal with students' negative attitude towards mathematics.

"Students don't give themselves a chance to pass ... because they

Teaching math means having to deal with student absentees.

"learning math means knowing rules and procedures" and enacts a "teaching by telling" format and s/he simply ignores her students' perspectives, then however consistent the beliefs are, her/his model is one that is based on domination and disrespect.
absent so much."

"[Students say,] 'Oh it's too hard for me and I just can't get it.'"

Learning math means coming to class daily and doing the work.

The model I constructed for Ms. Lynch also indicates how Walter Doyle and Gary Ponder's practicality ethic overwhelms Ms. Lynch's practical consciousness which causes her discursive consciousness to be colonized and ignored while in the process of teaching mathematics in the classrooms. Ms. Lynch has mostly peripheral beliefs: while her view of mathematics has remained stable (as evidenced by the kinds of problems she gives to her students), it seems the social factor tends to overwhelm her almost always and so, "forces" constant changes in the construction of her beliefs about teaching and learning mathematics.

4.3.2. Ms. Prahst. Ms. Prahst believes that mathematics consists of two levels: skills and procedures are at one level and concepts and thought processes are at another level. She believes that the secondary mathematics curriculum should already require students to think in abstract terms or about ideas and processes rather than just manipulating symbols (such as arithmetical and basic algebraic operations). She also believes that "the continuity of mathematics" makes it unique from other subject disciplines. These beliefs appear to be primary and central. Another primary and central belief of Ms. Prahst deals with what for her constitutes to be the changing context of school mathematics as a discipline: the integration of mathematics, science, and technology. She believes that earlier versions of secondary mathematics were geared towards the mastery of skills and procedures but the recent version requires mathematics
teachers to employ applications (such as modeling problems in business, economics, and sciences).

Ms. Prahst also believes that "students should not be held back" into taking higher level mathematics if they do not have the requisite background. Hence, she employs technology extensively because "technology is necessary to use to move on." Now this belief appears to be derivative and central.

For Ms. Prahst, even if the social factor — poor student attendance, low homework turnout, behavior problems of some students, and the relative isolation she experiences because of the incohesiveness of the mathematics department faculty and the lack of policy enforcement — may have an impact on the teaching and learning of school mathematics, she tends not to dwell on these realities. In fact, she sees that as part of the changing ethos of schooling. A successful and model mathematics teacher25, she refuses to dwell on "a golden age when it was easier to get 'work out of the students'" (Provenzo and McCloskey, 1996, p. 111). When students do not do the assigned (home)work, Ms. Prahst simply says, "you find yourself not wanting to repeat but just for the sake that they didn't do it, I better."

Thus, her belief model appears "unproblematically" in congruous with Ernest's model. Both practices and beliefs of Ms. Prahst seem to be influenced by her "dynamic" view of the nature of mathematics. Further, because she does not allow herself to be determined by the social context of teaching, there seems to be a consistency between her

25 According to the principal, Ms. Prahst is popular in CHS because she "can speak at the level of her students" and "students feel she tries sincerely to reach out to them" (September, 1997).
espoused and enacted theories and beliefs. For instance, Ms. Prahst's espoused model of teaching involves "negotiation" in which the teacher, according to Alan Bishop:

has certain goals and intentions for pupils and these will be different from the pupils' goals and intentions in the classroom. Negotiation is a goal-directed interaction, in which the participants seek to [modify and] attain their respective goals. (Bishop quoted in Paul Cobb, 1988, p. 96; see Bishop, 1985, p. 27)

Ms. Prahst's enacted model of teaching mathematics involves conversation and connected teaching.

4.3.3 Mr. Jack. Mr. Jack's belief model also seems to adhere to Ernest's model. But unlike Ms. Prahst, Mr. Jack is overwhelmed with the social realities of mathematics teaching. Consequently, there are manifest inconsistencies between Mr. Jack's espoused and enacted theories and beliefs. A primary belief, mathematics for him is all about how the syntactic domain of mathematics can be utilized to everyday situations. However, the belief is peripheral: in terms of degree of conviction and based on my observations, Mr. Jack tends to focus mostly on "baseline knowledges" -- rules, procedures, process as correct application of rules, etc. -- and does not seem to be too interested in real problem applications. Learning mathematics for Mr. Jack is being able to "show the process." To teach mathematics for him means "to try to make math fun." Doing this means any of the following possible activities which I failed to witness he employed: (1) exploring through experiments; (2) playing with technology; (3) "being able to apply mathematical concepts to things that [students] experience but maybe not think about in everyday life; (4) integrating mathematics and science, and; (5) "getting [students] to understand new concepts, new ideas, and proving their ability to analyze things."

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So how do the social constraints of teaching influence his enacted theories and beliefs-in-practice? We have learned much about Mr. Jack's dilemma in section 6.1. Mr. Jack's "low clientele perception," for instance, already denies the possibility of conducting experiments in his classes. Because, for him, students do not do their homework, are too lazy to practice, and "haven't learned how to learn," exploring concepts via experimentation and discovery takes time, and "time is not a luxury for me," he insists. Round robin absentees also make it difficult for him to conduct group activity-based experiments and/or discussions. In the interview excerpt below, he seems to imply that because he is usually caught up in other concerns such as control and student behavior, then "by the time you get started, it's time to quit."

Even starting that kind of method or approach [such as doing experiments] assumes that students have the skill to come to class, sit down, listen to instruction, and respond to instructions accordingly. [But] that is an assumption that in a class, and I don't have that luxury. ... The basic thing we don't have. You have the time constraint of a 40-minute period for doing group activities. It just takes so much time to just get kids settle down and get started. If you can get things done like click, maybe, in a 40-minute period, you could accomplish something. But it takes so much time to just get started. (Mr. Jack, third interview).

Mr. Jack does not use technology at all because he finds it difficult to bring appropriate equipment to different rooms at different times. Further, he insists that it takes time to distribute calculators in class because of the need to conduct two inventories (at the start and towards the end of class) and seeing to it that the calculators returned are still in good condition.

Mr. Jack does not discuss enrichment question or problems that require much thought because he thinks his students are not capable of dealing with problems that have
"wrinkles" in it. His main concern is that students must acquire "baseline knowledge," another primary and central belief. Integrating math and science takes time and we know how Mr. Jack feels about time constraints. More than that, we know how his low perceptions about his students tend to influence his decisions.

4.3.4 Mr. Taft. Mr. Taft's belief model meets Ernest's model. I find it interesting to compare Mr. Taft's model with that of Ms. Prahst's. While both of them are affected by the social realities of teaching in an urban setting, both try to overcome their situations and hence, they seem to exhibit consistencies between their espoused and enacted beliefs (i.e., practices). The only difference I see deals with what I perceive to be the dominant mode of knowing that each employs in her/his classrooms. In section 4.2, I claim that Ms. Prahst is more a relational than an impersonal knower (thus, subscribing to teaching and learning by negotiation) while Mr. Taft seems to exhibit the reverse (thus, subscribing to teaching and learning by imposition).

Almost like Ms. Prahst's view of mathematics, Mr. Taft believes that mathematics consists of two levels: the lower level consists of arithmetic and the upper level deals with theory and concepts. Further, Mr. Taft thinks mathematics is symbolic, neutral, objective, apolitical and context-free. Both beliefs appear primary and central. His espoused model of teaching mathematics, which he enacts very systematically in practice, is lecturing, teaching by telling - "show them [the] methods [and] ways of getting results that are being asked for" -- or teaching by imposition -- "the teacher attempts to constrain students' activities by insisting that they use the prescribed
methods" (Cobb, 1988, p. 96). Another enacted belief is the apparent lack of dialogue in Mr. Taft's classrooms.

Mr. Taft's espoused model of learning mathematics is the transmission model. Cobb describes the model as follows:

The central assumption of the transmission view of teaching and learning is that meaning is inherent in the words and actions of the teacher or in objects in the environment. (Cobb, 1988, p. 96)

Hence, Mr. Taft does not see the need for students to think creatively: "They don't need a lot of creative stuff on their part 'coz I try to basically lay it all out, 'Here's what you do.'"

Even his perceptions about the assessment techniques he use are guided by his primary, central belief that "there is closure, there is an answer" to every mathematical problem he gives. For Mr. Taft, an open-ended question is not authentic in the sense that there is always a specific, correct answer to the question.

4.4 Whose Myth? Whose Math? An Interruptive Reading of Subtexts of Other People's Constructed "Realities"

How can one avoid sinking into the mire of common sense, if not by becoming a stranger to one's own country, language, sex and identity?

Julia Kristeva, *A New Type of Intellectual: The Dissident*

Writing the three sections above has been a difficult personal exercise. Purposefully, I have moved in contradictory spaces to open up rhizomes and to illustrate how the process of translation -- of constructing other people's realities -- defies the simplistic (modernist) method of binaristic thinking and inferential logic, at the very least. Again, I keep going back to the Deleuzean lines of becoming, those lines that are less rigid but more pliant and supple than the clearly defined lines of segmentarity. To
understand the structure of complexity of the *others* in this study whose lines of becomings are always already marked by ambivalence, assimilated contraries, contingency, and transitoriness, and whose realities have been narrowly constructed within this discourse means to confront an illimitable matrix of metaphorical and literal misunderstandings. In an anti-essentialist sense, it is to confront the "forms of madness" that structure their thoughts, beliefs, conceptions, *et cetera*. But "that's the way things are," I know: the epistemo-ontological nature of political knowledge is rooted in an "agnostic process [of] dissensus, alterity, and otherness" (Homi Bhabha, 1994, p. 23).

*Once Again: Student Resistance.* Rereading subtexts, I pose the question: why does Copeland High School experience the phenomenon of round robin absentees? A related question, I think, is: why is there an apparent student resistance (= silence, resignation, rebellion) to learning mathematics? If mathematical truths are "essentially good," then how come the mathematics teachers in this study experience difficulty deploying "the truth" of mathematics? During one of my last visits to the principal, he reminded me that his mathematics teachers were (and still are, obviously) caught up in the absent presence of a mathematically anxious student body, whose fractious attitude towards mathematics made it extremely difficult for teachers and students to talk about mathematics in meaningful ways. "Our students are good ... they wanna learn, but we got them that way," I remember him saying a couple of times either in his office or along the halls of Copeland High. So, naively at first, I asked: what are teachers doing about it?

But vis-a-vis the teachers' claims in this study and having ethnographically immersed

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*By an agnostic process, I understand that to mean the process of making meanings out of ideas that can be neither proved nor disproved.*
myself in their culture, it seems to point to a larger problematic of controvertible nature: what is society doing about it? Or, yet a better question, what is it that the larger society is not doing?

There are two important ideas related to student resistance that are worth thinking about. I should say that these ideas are not popular with critical pedagogues. The first idea is stated in a form of a question: Where does one locate students' resistance? Both Ms. Walters and Ms. Prahst have talked about the "give-up-too-easy" or the "get-by" attitude of their students. Several times in the interview, Ms. Prahst would say, "I wish they [i.e., students] would be willing to do the work." Ms. Walters, too, has argued that students are willing to do two math-credit hours of minimum work in mathematics, and no more than that. Second, the following comment made by Ms. Walters seems to me a problem on resistance of the post-Kozol type: "For a particular student who has the interest, we can find the resources, computer-wise or individual tutoring or after school, if the student is willing to stay with a particular teacher who'd be willing to work with them." The teacher-participants in this study lament on the fact that too many students at CHS do not have enough interest to make things work well for them.

The Social Reality of School Mathematics. Perhaps, beyond the naivete of psychological theorizing, it is the construction of the social reality of mathematics that is problematic. The social reality of mathematics does not self-exist, but rather is a political discourse that is located within competing junctures -- between those who claim they know what constitutes mathematical knowledge-in-reality and those dissidents whose minority discourse subscribes to the belief that mathematics is but a performative
mythology. For instance, Suzanne Damarin's (1995) claim that the argument "mathematics is a male domain" (p. 250) implies a "double argument" that "women could not do mathematics ... [and] that they should not" (p. 251). In this study, all four teacher-participants claim that the female students in their classrooms are actually performing better than do the males. But, then, I ask: To what extent does the deployment of an "impersonal" mode of knowing construct an invisible pedagogy -- a secondary elaboration -- that further reinforces women's status (e.g., "as obedient, rule followers") in the patriarchy of Western mathematics? Might that plausibly explain, too, why so many urban male students -- classified as minorities by race and by social class -- are resisting mathematics because they perceive of mathematics as being deployed as a technological tool of (displacement)(partitioning)(exclusion)(stratification)?

Issue With Ms. Prahst: "Poisonous Pedagogy" and School Mathematics Not for the Present but for the Future? Related to the preceding paragraph is the following comment made by Ms. Prahst which I find problematic and unfair to students: "[When students ask,] 'why are we doing this stuff today?' I tell 'em sometimes, 'you probably will have children in school one day. Learn it for your children if it means nothing to you because there's nothing worse than your kid coming to you and you get frustrated because you don't remember the stuff or you don't have the background for it'." So, is the teaching and learning of school mathematics mainly motivated by some, unknown future desire? In Democracy and Education, John Dewey (1944) goes against the familiar idea that education is about preparation (for life) or getting ready for the future. Dewey (1944) writes, "The future prepared for is a long way off; plenty of time will intervene
before it becomes a present. Why be in a hurry about getting ready for it" (p. 55).

Rather, Dewey (1944) suggests that because students live in the present, teachers need to
develop conditions in the present that are "as educative as possible" (p. 56) and "as rich
and significant as possible" (p. 56).

From a different perspective, Ms. Prahst's comment above illustrates Alice
Miller's notion of "poisonous pedagogy." Nel Noddings (1994) defines it in the
following way: poisonous pedagogy "includes all those things we do to children for their
"own good" against their own wills and interests and, then, forbid them to complain about
it" (p. 94).

Is Mathematical Knowing Mathematical Knowledge, and Vice-Versa? In 1977,
Morris Kline (1977) wrote about "naive mathematician's pedagogy" in the following way:

Mathematicians have a naive idea of pedagogy. They believe that if they
state a series of concepts, theorems, and proofs correctly and clearly, with
plenty of symbols, they must necessarily be understood. This is like an
American speaking English loudly to a Russian who does not know
English. (Quoted in Ball, 1988, p. 44; see Kline, 1977, p. 117)

A teacher's belief that "math is math" is often grounded in Kline's perspective above. It
seems to me that the problem may lie at the point in which the teacher confuses between
mathematical knowing and mathematical knowledge. Both Mr. Taft and Mr. Jack believe
that because school mathematics is guided by rationalism, then mathematical knowing is
simply and unproblematically acquiring and becoming proficient with the semantico-
syntactical nature of mathematical knowledge. Of course, the naivete can somehow be
"mapped" back to the teachers' epistemological background.
**Issue of Prerequisites.** All four teacher-participants in this study insist that a significantly large number of their students do not have the prerequisite arithmetical skills and are obviously frustrated by that fact. As a consequence: the teacher-participants (except perhaps for Ms. Lynch) are not motivated to do group work; some students in Ms. Prahst's class may never be able to learn fundamental skills because calculators could actually do it for them; "math is not fun" for Mr. Jack and his students, and; those students that have been labeled "noncollege-bound" in Mr. Taft are forever "stuck" in their place and even if those "lower-track" students finish the noncollege prep sequence, they still will not be able to tackle "real hardcore algebra stuff," says Mr. Taft.

**What's Easy and What's Not: The Issue of Labels Again.** Valerie Walkerdine and Noddings problematize binary thoughts such as higher level/lower level and abstract/concrete. Each calls into question the privilege we-who-often-seem-to-know-more accord the abstract and higher level processes as if those are predetermined or suppositious facts and, thus, are performed in the slenderness of tradition. Two points are in order. First, I am reminded of Mr. Taft and his colleagues who, many years ago, suggested that some students take as a third and final mathematics course topics that deal not with precalculus matters but with "everyday life" (such as consumer math, business math, etc.). The reception they received was actually a Pilate's response from the board of education at that time. Recently, Ms. Prahst acknowledged the significance of "relevance" of school mathematics:

> When we are going to be forced to require three years of mathematics for all students, we cannot make it algebra 1, geometry, algebra 2 or algebra 1, geometry, and mathematical modeling. The third course needs to be a wide
more variety of choices: something statistical in nature, something somewhat business related or consumer math. ... There's a lot of math that's required in every field and I think we need to be more well-rounded in what we're presenting to the students and not just what we're currently doing. ... There is not a whole lot of relevance because I still believe realistically a large majority of them are not going to further education. (Ms. Prahst, third interview)

Second, Mr. Taft and Ms. Lynch distinguish real algebra from, using Mr. Taft's words, "watered down, milk run, whatever you wanna call it" algebra. Also, Mr. Taft insists that students take either algebra/geometry, if they have the background for it, or should simply take a "life-skills" mathematics course, a course that is meant for "not stupid but at-risk" students.

The two points above lead to the pernicious practice of labeling in school mathematics. I find the labels constraining (from the first point) and problematic (especially for the second point) because, beneath the spoken words is the unspoken, unarticulated intention, that is, the deployment of what Noddings (1994) has referred to as an "'inferior' course of study" (p. 94).

Textbooks and Changes in Content. The teacher-participants in this study seem all too dependent on the textbooks. They should, of course, because they are held accountable for teaching particular content requirements. The changing scope and depth of mathematical content is not for them to resolve by themselves because the textbooks and the reform movement do it for them. "It's the way textbooks are structured," Ms. Prahst insists. She claims that students are "not forced to tackle some things" in the present context such as proving, "which is fine" for Ms. Prahst. That explains why I have not witnessed a lot of proving in the geometry classes that I have been into. But in the
ones that I've been into, I tend to agree with Schoenfeld (1994) when he says, "in most instructional contexts proofs has no personal meaning or explanatory power for students" (p. 75). Like in Mr. Jack's geometry classes, students are indirectly taught to value form over content such as the T-column or the flowchart form. In those classes, I did not witness Mr. Jack employ his notion of "process," that is, "you're given a problem. How are you gonna approach it, how you're gonna attack, [and] how you're going to plan your solution," says Mr. Jack. Schoenfeld (1994) articulates it very well when he insists that proof-writing for students "is a ritual to be engaged in, rather than a productive endeavor" (p. 75).

**Issue With Mr. Taft's Belief That Math is Interpretation-Free.** Mr. Taft's insistence that in mathematics, "there is no interpretation," is somewhat problematic. Interpretation for Mr. Taft seems narrowly confined to mathematical procedures and the nature of mathematical answers. When Mr. Taft claimed that a "student doesn't have to interpret what [his] question is in order to be able to do it," I found proof in the precalculus textbook they were using that required an interpretation of meanings:

[Problem 26, Chapter 8.1] The leaning tower of Pisa was originally perpendicular to the ground and 179 feet tall. Because of sinking into the earth, it now leans at a certain angle $\theta$ from the perpendicular, as shown in the figure. When the top of the tower is viewed from a point 150 feet from the center of its base, the angle of elevation is $53.3^\circ$. (a) Approximate the angle $\theta$. (b) Approximate the distance $d$ that the center of the top of the tower has moved from the perpendicular.

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27Of course, Mr. Jack may not be aware of this.
Strain theory brilliantly captures the essence of all four teacher-participants' mathematics teaching practices. A "theory of the social" (pp. 395-396), Ortner (1994) writes, "the strain theory places greater emphasis on the analysis of the system itself, the forces in play upon actors, as a way of understanding where actors, as we say, are coming from. In particular, a system is analyzed with the aim of revealing the sorts of binds it creates for actors, the sorts of burden it places upon them, and so on" (pp. 395-396). Teaching mathematics for Mr. Jack has been an experience of "pulling teeth" and working with "extremely, apathetic students" and uncooperating parents. Mr. Taft's coping mechanism for dealing with round robin absentees has been lecture, through an impersonal process in which students are taught individualistic (isolationist) thinking. Ms. Lynch personifies the teacher whose teaching practices is powerfully determined by the system and the workplace conditions. A good teacher that she is, Ms. Lynch's teaching practices, nonetheless, appear always in conflict with the kind of culture students create for themselves. Ms. Prahst exemplifies a mathematics teacher who can deal easily with difficult situational contexts and structural/workplace conflicts. Part of her success may be due to her relational-based epistemology and her continuously evolving mathematical beliefs and pedagogical practices. Ms. Prahst uses technology to her advantage; she collaborates with physics teacher Ms. Stevenson; she makes sure she is up-to-date on developments in school mathematics reform, and; she likes to take risks and often reminds herself: "if what you didn't do go well, then don't blame yourself, regroup, [and] come back tomorrow if you can."
CHAPTER 5

URBAN MATHEMATICS TEACHING AND SUBJECTIFICATION --
THE PRODUCTION OF A STUDENT'S MATH SUBJECTIVITY:
A FOUCAULDIAN TALE

Maybe the problem of the self is not to discover what it is in its positivity, maybe the problem is not to discover a positive self or the positive foundation of the self. Maybe our problem is now to discover that the self is nothing else than the historical correlation of the technology built in our history. Maybe the problem is to change those technologies.

Michel Foucault
Political Theory

This week I was teaching the distance formula and I was watching them work on Wednesday. So on Monday we did measurement on a centimeter dot paper and then we changed into coordinates and wrote down the coordinates. And then they learned the distance formula. So Wednesday was the first chance for them - on their own - to put it all together. [While] they were measuring and calculating, it just dawned on me - they didn't learn anything this week! They were trained. And there's a difference between learning and training. How much training do we do instead of learning? You do have to be trained to an extent ... but they are being trained in the skills. Somehow we need to figure out how we need to address students so as to require [them] to think more.

Ms. Prahst, Third Interview

Care was taken in each course to make sure that all processes and all levels of thinking occurred in a balanced manner.

Public Schools Mathematics
Course of Study, 1993-1994

ASIDE: Mapping a Discourse on Subject(ivity)

Mathematics, or at least the process of mathematizing, means different things to different people. If mathematical affinity is measured first by desire and by cognition second, then indeed students’ penchant for mathematizing is bound to vary. Some students may prefer algebra because it is procedures-and-rules driven. Others may prefer geometry because they think they have the spatial skills and the “ability” to deal with conceptual knowledge. There, too, are those whose desires lie in an interjacency. Of
course, there are students who do not find mathematics relevant in their lives at all. In some significant way, I think the question, "When is a symbol symbolic?" is linked with the performativity of an individual’s desire (= motivation), constructed through subjectification, and with her/his desidero always already in a "hysterical relation" with her/his cogito. The “desire to know” presupposes the absent presence of desire in knowing. Desire then, as a personal construct, is related to a student’s subjectivity which always already occurs in the intersubjective domain: the I-I and I-Thou relate cyclically.

Marshall Alcorn (1994) insists that a fundamental -- but central -- difference between psychoanalysis and poststructuralism deals with how each understands the seemingly equivocal phrase, "subject of discourse." The symmetrical reversals have, in position, led to differing epistemological perspectives: poststructuralists insist that the subject is a function of discourse while psychoanalysts, on the other hand, assume that the discourse is a function of the subject. But there are problems with both perspectives, as Alcorn points out.

Structuralists and poststructuralists tend to ignore the specific discourse functions (described by psychoanalysts) that, lying within the subject-system, operate upon language. Psychoanalysts tend to ignore the discourse systems (described by structuralists) that, lying outside the domain of the subject, compose and situate the subject. (Alcorn, 1994, p. 20)

For Jacques Lacan, both subject and discourse are cyclically and "dialogically" related: "the subject operates upon discourse and discourse operates the subject" (Alcorn, 1994, p. 27). Alcorn (1994) claims that subject functions -- such as repression -- tend to affect the social discourse that is formed (i.e., there are functions within a subject’s self that interact
with the social discourse to "produce discourse effects" (*Ibid.*). On the other hand, there are *discourse functions* -- such as ideology and knowledge -- that tend to influence how the subject "interacts in a discourse community" (*Ibid.*).

Within poststructuralist thought, the nihilistic proclamation of the "death of the subject" implies that the subject has been radically decentered, that is, the Cartesian subject as an autonomous, self-generator of meanings has dissolved. Poststructural theorists then affirm the shift of the subject as *textually* a linguistic construction. Some schools of psychoanalysis argue similarly. Bice Benvenuto and Roger Kennedy (1986) write, "the subject is no longer, as in traditional psychology, a unified collection of thoughts and feelings, but is 'de-centered,' marked by an essential split [between the subject and the knowledge he has of himself]" (*p. 18*). The psychoanalyst Lacan made the poststructuralist move to dissolve the subject but the diffluence actually means that:

Lacan's subject disappears in the sense that a particular component (long idealized by psychoanalysts), the ego\(^2\), can no longer aspire to control self-components and functions. Lacan's subject also disappears in the sense that human nature is not determined by a universal "inner nature" but by historical, social, and linguistic forces. Lastly, Lacan's subject

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1 Benvenuto and Kennedy (1986) claim the differing views such as a subject's fragmented self versus a unified self are perhaps differences in their readings of Freud's texts. Freud himself, they add, was "far from clear on this point, perhaps because Freud was struggling with new concepts while still in debt to the older language of nineteenth century determination" (*p. 18*).

disappears in the sense that the psychoanalytic cure cannot be defined by a reintegration of the fragmented self-components\(^3\). (Benvenuto and Kennedy, 1986, p. 28)

This being the case, Lacan's interest on the subject shifts to the "subject's position in discourse" and the "use [of] discourse to reposition the subject" (Alcorn, 1994, p. 29). Which also means to say that Lacan perceives the subject not as a "passive entity constituted by participation in social language" (*Ibid.*) but as an active agent that resists and possesses the "unique ability to deny, dismiss, or deform social directives ... [and] to counteract forces that in other contexts would successfully constitute subjects" (*Ibid.*).

The preceding discussion based on Alcorn's (1994) rereading of Lacan has inspired the way this analytic chapter is constructed. At the outset, I claim that mathematics teachers and students in Copeland High School each embody the Lacanian model of the subject. Despite the the panoptic/structural gaze that teachers experience daily in their work culture and the (pedagogical)(structural) gaze that students are being subjected to, both groups tend to manifest *resistance* (both overt and latent). Alcorn (1994) writes, "The presence of conflict within [the subjects] make it possible for [them] to 'contain' discourse material that is not a simple reflection of the social discourse systems that 'position' [them]" (p. 41). Consider the students, for instance. Not a few of those in Mr. Taft's classrooms almost always in peaceful forbearance partake in the silent majority. In a way, *silence* for these students becomes a form of inward resistance.

\(^3\) So, *is Lacan a poststructuralist?* Yes, to the extent that his rereading of Saussure has led to "the reversal of the Saussurian sign." See Benvenuto and Kennedy (1986, p. 24) for more details.
Silence is manifested through students' eyes and bodily quiescence that speak of their undesire to talk about mathematics or perhaps their inability to do mathematics in their own terms. There is outright resistance, too, and this I refer to as rebellion. Many students in Ms. Lynch's classes give an appearance that they rebel against her, against the kind of mathematics she teaches and imposes on them. Resignation is also a form of inward resistance. It is manifested through a kind of silence that disturbs. It causes a breakdown in communication, a missing linchpin in learning the language of mathematics. Many students in Mr. Jack's class refuse to participate and prefer the epistemic mode of resignation -- comfortably "vegetating" (to use Mr. Jack's word) and appearing disinterested and "lazy."

Of course, the discourse on resistance is not a simple matter. Echoing Paul Smith's notion of the subject, Alcorn (1994) writes, "the subject [i]s an entity constructed by contradictory ideological interpellations" (p. 30). The subject in actuality and always in "presence of conflict" (Alcorn, 1994, p. 41) is an effect of competing discourses.

**Episode 9.** Students in Ms. Lynch's class are given a worksheet on linear equations.

Amanda: Hey Ms. Lynch, I'm not understandin' this. How do you do this?

Ms. Lynch: Well maybe if you're here often, then you'll know what to do.

*Amanda looks at me (researcher) and says:*

Amanda: I work, okay? I don't need to learn this now. I'll learn this in summer school.

---

4 January 7, 1998. Amanda is an African American student in Ms. Lynch's Algebra 1 class. They were solving linear equations.
In the situation above, Amanda's desire to learn mathematics is constrained by three factors: (1) work for her comes first; (2) if she does not get to learn it, then she can relearn it in summer school, and; (3) Ms. Lynch does not appear to her to be very interested in helping her learn it. Thus, Amanda, possibly in conflict, and subjects, in general, who tread through rhizomes are consequently formed via a "colligation of multifarious and multiform subject positions" (Alcorn, 1994, p. 41; see Smith, 1988, p. 32). And, because there is no discourse that emits the right signs, then resistance is always already a precondition of the subject. This may explain, albeit partly, Amanda's resistance in Ms. Lynch's class.

Hence, by subjectivity, I mean the way Alcorn defines it:

Because, in fact, human subjectivity is a particularized process constantly at work in organizing and emphasizing experience, it is the case that particular human subjects not only "contain" different speech but also create and internalize for themselves particular "editions" of social discourse. Subjectivity, thus, is itself an individualized process of subject functions that under particular conditions alter, select, and symptomatically enscript the discourse of the larger world of social interaction. (Alcorn, 1994, p. 32, italics mine)

Introduction: The Interpellation of the Subject

I hate this math teacher. As soon as I get in this class, all I hear is "do this."

Nekesha, math student

Lacan claims that there are at least three "synchronous, overlapping" (Hazard Adams and Leroy Searle, 1986, p. 733) stages of human development that are related to the formation of our subjectivities: Mirror, Imaginary, and Symbolic. Simply put, the mirror stage represents a child's initial discovery of her reflected image in the mirror.

5 December 1, 1997.
The child forms her identity through the image of her self which also means to say that
the child alienates herself through her image that is the other of the (child's) self. Later
this "other" undergoes a second alienation -- that of the relation of her image in and with
other people. The imaginary stage concerns the child's dual relationship with her
mirrored self. The symbolic stage, third and last, marks the child's "entrance into
language, where [she] is constantly deferred along [a] chain of signifiers" (Ibid.). The
symbolic stage is significant because the child deals with various positional signifiers that
are mainly products of particular social and cultural discourses. Mark Bracher (1993)
claims that the dialogical interactions -- the symbolic interactional activity -- that occur
between a person and others are in actuality about the meeting of each other's signifiers,
that is, what happens to our sense of being or identity is determined to a
large degree by what happens to those signifiers that represent us -- our
master signifiers -- particularly the alliances they form with and the wars
they wage on other signifiers. (Bracher, 1993, p. 25)

To illustrate Bracher's point, in school mathematics education we often deal with how the
subject of mathematics as a "regime of sign(ifier)s" is being deployed as a way to
construct a student's "math subjectivity." Tony Brown writes:

Teaching is not about transferring the teacher's intention. Rather,
teaching is more about cultivating the significance the learner gives
to the teacher's input, which necessarily entails a reconciliation of
personal experience with social coding. (Brown, 1997, p. 97)

Brown anticipates the "war of signifiers," that is, the negotiation of mathematical
meanings through signifiers but, more importantly, foregrounds the Lacanian perspective
that teachers' mathematical practices emerge mainly and are imbricated in a language
plane in which the constitutive elements are signifiers, that is, those codified arithmetics of socialization. And, as social constructivists would have it, the "acculturation" mainly concerns students' mis/use of the signifiers that are always already invested with specific functions (as they are defined by the mathematics community). The two situations below illustrate what I mean here.

**Episode 10.** (Ms. Lynch's Developmental Algebra A Class, December 9, 1997) Ms. Lynch and her students are discussing applications of the operations of algebraic expressions. The statement below that Ms. Lynch makes is related to the worksheet the students were asked to accomplish the day before this.

Ms. Lynch: When a problem asked you to find area and perimeter, and some of you didn’t label which is which, that’s not correct. It shows, first, you did not read directions, and second, you’re not labeling it properly. It's sloppy. (Pause.) The importance of finding perimeter and area is that with perimeter, you’re adding and combining like terms, and with area, you’re multiplying like terms. I need for you to know when to add and when to multiply.

***

**Episode 11.** (Ms. Prahst's Geometry Class, January 5, 1998) The topic of conversation is ratio and proportion, an introduction to scaling, and similarity.

Ms. Prahst: If there are 17 girls and 10 boys, we have \(\frac{17}{10}\) or 17:10.

Chris: Can we write it as \(1\frac{7}{10}\)?

Ms. Prahst: No, because you lose the comparison . . . the uniqueness of what those numbers represent.

An initial understanding of the construction of a student's math subjectivity necessitates a partial framing of a discourse in two mutually implicative axes, that of knowledge and power. The construction is purposefully Foucauldian as it seeks provisional responses to the following questions:

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6 January 5, 1998, Geometry. Topic: Ratio, Proportion, Scaling and Similarity

7 Foucault speaks about a third axis, that of ethics. This dimension, which is implicit in the goals of this study, deals with our constitution as moral subjects of our acts and the role of
How are we constituted as subjects of our own knowledge? How are we constituted as subjects who exercise or submit to power relations? (Foucault quoted in Paul Rabinow (Ed.), 1984, p. 49)

Note the "we" above refers to the students in this study. In this research, Foucault's questions are related to Research Question Two, which I rewrite below for convenience:

To what extent do pedagogical practices subjectify students into a way of thinking about/acting/doing mathematics in the classrooms?

Specifically: In what way/s may these practices affect the way students learn mathematics? In what way/s may these practices affect the evolution of mathematical ideas in the classroom?

On second thought, the questions stated above pursue the "end of pedagogic innocence and of humanist nostalgia" by an "unthinking-rethinking" of a subjective economy of power of school mathematics that is constituted-as-natural (thus, rendering it as unproblematic), in a regime of mathematics pedagogy that consists of rules and discursive acts and from which the effects of mathematics are then realized in a student's epistemic subjective frame as "continuous, uninterrupted, adapted, and 'individualized'" (Foucault quoted in Rabinow (Ed.), 1984, p. 61).

The knowledge axis is explained in two parts, both of which are based on Lacan's discourse of the university (section 5.1) and discourse of the master (section 5.2). The self-transformation through a "critical ontology of ourselves" involving a process of denial, at the very least. The implications of this axis is explained in the concluding chapter.

8 The term in italics is inspired by Foucault's notion of a "new 'economy' of power."
power axis deals with Foucault's techniques of subjectification (assumed in sections 5.1 and 5.2 and fully extrapolated in section 5.3) with an eye on framing a genealogical discourse on mathematics pedagogy. In the two section that follow, I deal with the Lacanian discourses. Here I also assume that readers have a working knowledge of Foucauldian subjectification.

5.1 Knowledge Axis I: Lacan's Discourse of the University — (Un)Rethinking School Mathematical Knowledge

Calls for reform in school mathematics suggest that new goals are needed. All industrialized countries have experienced a shift from an industrial to an information society, a shift that has transformed both the aspects of mathematics that need to be transmitted to students and the concepts and procedures they must master if they are to be self-fulfilled, productive citizens in the next century.

Curriculum and Evaluation Standards
NCTM, 1989

[What are some reasons] why girls feel compelled to take some mathematics and the contradictions which result when they are then confronted with a distinctive hierarchy of pathways according to the mathematics subject into which they are channelled? The message they are receiving is that, on the one hand, mathematics is vitally important for their futures but, on the other hand, they may not be good enough to study the form of mathematics which opens up these future options.

Sue Johnston
Choosing Mathematics: "You Need It Even if You Don't Want to Do It"

The intrinsic, unquestioned value society places on knowledge, following Bracher (1993), already acculturates students to "weave themselves into the system" (p. 56). The discourse of the University operates mainly through (the production of) knowledge and "nothing else. .... Individuals are to act, think, and desire only in ways that function to enact, reproduce, or extend

Linde: What do I do with this?
(y + 3) / 4 = 7
Ferdie: What are you supposed to do?
Linde: I don't know.
Ferdie: Okay, suppose we solve the equation?
Linde: Yah.

9 I refer the reader to my Foucauldian sections on Chapter Two.
The System [= knowledge]" (p. 55). Changes and reform in school mathematics education in the present era are brought about not primarily by fundamental humanist concerns toward the "individual" in the schools but by a "technological shift ... [that] ... has become an economic reality" *(Standards, 1989, p. 3).*

The *Standards* assert: "As society changes, so must its schools" *(Ibid.)*. Which, perhaps, implies that if school changes, then so must its students. What, then, is the role of mathematics in our schools that are situated in the post-industrial age? Schools, I believe, aim at producing "math cyborgs" in which the math environment envisioned is to have the following characteristics:

Woven into the fabric of the *Professional Standards for Teaching Mathematics* are five major shifts in the environment of mathematics classrooms that are needed to move from current practice to mathematics teaching for the empowerment of students. We need to shift —

* toward classrooms as mathematical communities — away from classrooms as simply a collection of individuals;*
* toward logic and mathematical evidence as verification — away from the teacher as the sole authority for right answers;*
* toward mathematical reasoning — away from...
merely memorizing procedures;
• toward conjecturing, inventing, and problem solving — away from an emphasis on mechanistic answer-finding;
• toward connecting mathematics, its ideas, and its applications — away from treating mathematics as a body of isolated concepts and procedures. (Professional Standards, 1991, p. 3)

Teachers deploy the pedagogical gaze as a way to subjectify students to particular discourses, that is, to specific cultural and disciplinary practices. The discourses, in effect, influence how students' subjectivities and identities are constructed. For instance, algebra and geometry are viewed as a system of "preconstituted knowledges," knowledges that all students in secondary schools are supposed to acquire without question. Here, students are subordinated by the knowledge and belief of society about the value of mathematics. Mathematics, as a system of knowledge, is "being taken as an end in itself rather than as a means to benefit either individual subjects or society in general"

* multiply by 4?

Ferdie: Okay, suppose you do that. So what do you get?

Linde: \((y + 3) / 4 = 7 \times 4\). So \(y = 28\)?

Ferdie: Wait, you still have a + 3 here on this side [i.e., left]?

Linde: Divide it?

Ferdie: Are you sure?

Linde: I don't know.

Ferdie: How do you solve \(y + 3 = 28\)? Remember how you solve the previous problems?

Linde: Oh, cross out the 3!

Ferdie: Yah, you can try that.

Linde cancels out the 3 in the following way: \(y + 3 = 28\).

Ferdie: Wait. Is that the way to do it?

Linde: I don't know. Maybe I can add -3?

Ferdie: Good. Try that.

Linde does the following:
(Bracher, 1993, p. 56).

\[ y + 3 = 28 \]
\[ -3 \]
\[ y = 28. \]

**Episode 12. (Ms. Prahst's Mathematical Modeling)**

Ferdie: You added -3 on this side. What would be its effect on the other side?

Students in Ms. Prahst's class were asked to determine the slope of the following pair of points: (12, 3) and (-4, 7).

Joshua: Why use the negatives here?

Linde: Oh.

Ms. Prahst: Because that's part of life. We can't do without them.

Linde tries again: \[ y + 3 = 28 \]
\[ -3 = -3 \]
\[ y = 24. \]

The master signifiers -- which Lacan calls the Symbolic Others -- are "identity bearing words" (Bracher, 1993, p. 23) that hegemonically intervene through the subjectifying *points de capiton* (Lacan, 1977, p. 303) -- "quilting points" that interpellate and "'button down' a subject [with the signifiers]" (Bracher, 1993, p. 29). In the Professional Standards in the Teaching of Mathematics, the following appears:


Social constructivists and didactic theorists talk about the impact of institutionalized mathematical processes. Correct mathematical solutions, for instance, are usually assessed vis-a-vis the symbolic logic of mathematics and seldom "on the student."

Students are considered ideal students if they are willing to "exhibit" expected processes and can participate in the further production of knowledge.

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The lecture method -- teaching by telling, teaching by imposition, the Socratic maieutic -- in teaching mathematics induces an interpellative effect, itself a mechanism in the deployment of the discourse of the university. John Smith (1996) writes, "(t)elling accentuates the sense of knowledge transfer in teaching" (p. 392) and "defines what students should do to learn: listen, watch, and practice" (p. 392). Students' subjectivities, then, tend to get anchored in passivity. They derive their sense of competence not from their own selves but "largely due to their teachers' competence" (Smith, 1996, p. 392). Recall Mr. Taft, whose sole method of teaching is direct instruction. Mr. Taft's method clearly illustrates the "subordinating effect" knowledge has on students' subjectivities. Students' spontaneous thoughts are already pushed aside in favor of formal thoughts in mathematics. There is no room for negotiation or creative thinking. Students simply produce knowledge by following rules and procedures: "if the student[s] answer, [they] demonstrate that [they] know; otherwise the need for knowledge becomes apparent, and that calls for information, for teaching" (Brousseau, 1997, p. 29).

Recall, also, all four participants' converging perspective that mathematics teaching is not affected by the issues of race, culture, and gender. Translated in another way, mathematical knowledge is viewed as stable, context-free and consequently dehumanized by didactical processes. Mathematics teachers are assumed to have the most mathematical knowledge in the classroom; an unintended effect this has on students' subjectivities is that they may tend to rid themselves of knowledge that may impair them from acquiring the "appropriate, correct" knowledge. Thus, they become
“amorphous, nonarticulated substance to be articulated by the discourse” (Bracher, 1993, p. 54). Consider Episode 13 below.

**Episode 13.** (Ms. Lynch (L), Developmental Algebra, January 5, 1998) Students are solving the equation: \( 3x - 4 = 5 \). Chris, on the board, solves the equation in the following way:

\[
3x - 4 = 5 \\
\rightarrow \frac{3}{3}x - \frac{4}{3} = \frac{5}{3} \\
\rightarrow x - \frac{4}{3} = \frac{5}{3} \\
\rightarrow x = \frac{5}{3} + \frac{4}{3} \\
\rightarrow x = \frac{9}{3} \\
\rightarrow x = 3.
\]

L: That is not usually easy to do. I suggest you add 4 first and then you multiply or divide.

Ss: Why?

*Ms. Lynch appears to ignore the query. She then shows them the “easy” way, as follows:*

\[
3x - 4 = 5 \\
3x = 5 + 4 \\
3x = 9 \\
\frac{3}{3}x = \frac{9}{3} \\
x = 3.
\]

*Students are given a few more examples to “push” the idea of adding/subtracting first and then multiplying/dividing. Later, Ms. Lynch gives them a few literal equations to solve, and then the class ends with a worksheet activity.*

When students ask "why" the procedure requires addition/subtraction to be performed first, Ms. Lynch does not appear to be too interested in addressing the question. Indeed, one of those taken-for-granted ideas (proof by convenience, perhaps?) about teaching the
process of solving simple (linear) equations is the sacred "order" of operations: apply the addition property for equality first and then the multiplication property next.

Episode 13 illustrates how students' own thinking about solving linear equations leads to a didactical phenomenon called *metacognitive shift to procedures*. Students tend to accommodate without assimilation because procedures acting as certain, stable knowledges are viewed as time-tested recipes. Episode 13 appeared in conflict with later situations in which students in Ms. Lynch's class were asked to solve equations such as the one below:

\[ 6 = \frac{3}{2}x + \frac{1}{2}(x - 4). \]

Here, Ms. Lynch suggested they "multiply first" and then "add/subtract." Students appeared confused because they thought about applying the distributive law first and then carry out the usual procedures. But Ms. Lynch insisted that "multiplying first will allow them to not deal with the fractions."

5.2 Knowledge Axis II: Lacan's Discourse of the Master —
The Dominance of Signifiers in Mathematical Practice

(Mathematics is generally performed in a social sphere and there are definite requirements for participants. So there is a dual task of enabling the student to be conventional in her language usage but at the same time inventive in building structures and meaning for themselves.

Tony Brown
*Mathematics Education and Language: Interpreting Hermeneutics and Post-Structuralism*

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For Lacan, the discourse of the master is concerned with the sociopolitical currency of master signifiers and the "promotion of a particular philosophy or politics .... All teaching, in fact, begins as a discourse of mastery" (Bracher, 1993, p. 60). Science, for instance, operates mainly through master signifiers. Bracher writes:

Science, too, is in solidarity with the discourse of the master. "At the present time," Lacan says, "our scientific discourse is on the side of the master ...; it represents him/it as such." Science, as we have seen, "is not at all an affair of the progress of understanding." Rather, it "is something that ... always functions to the benefit of the discourse of the master." In fact, "science is what constitutes, maintains in force, the discourse of the master." The point here is that although science claims to be devoted to understanding the real through empirical research, it effectively functions to promote the various master signifiers that dominate it. And these master signifiers are not limited to those that structure the explanatory paradigms of the scientific disciplines themselves; they also include the master signifiers that guide the larger social and political agendas of our society. (Bracher, 1993, pp. 60-61, italics mine)

Mathematics as a kind of science also promotes its own set of master signifiers. But, following Renata Salecl's (1994) polemic, mathematics teachers are not necessarily Masters. In fact, they always have to point to "knowledge that is outside [them]" (p. 168). In fact, they are "polite" and "responsible subjects" to the socioculturally recognized knowledge of the Symbolic Other. Students' subjectivities, then, are implicated in the force of the master signifiers, that is, fundamentally constituted in the Symbolic Otherness of the master signifiers of mathematics. Mathematizing involves not mainly what students think but how master signifiers are used in context. Mathematics
teachers themselves often construct their notions of appropriate solutions based on conventionally, accepted signifiers.

Mr. Jack's playful use of metaphors exemplifies the tools of the master discourse. In the situation below, the use of the *hourglass* as a metaphorical signifier is a convenient method for understanding and mastering the concept of nonzero reciprocals.

**Episode 14.** (Mr. Jack (J), Developmental Algebra A, November 3, 1997) Students are reviewing basic operations on real numbers.

*J:* Just for review, let's add 7 - 9. How do I do that?

*Jen:* I don't know.

*J:* Can you remember the rule? Cover, difference, and copy the sign.

Then Mr. Jack proceeds to answer about 7 problems involving addition and multiplication of integers.

*J:* So those are the rules basically. We use them time and time again. We use them almost instinctively. Now let's go to reciprocals. Okay, so if you have a number like \( \frac{2}{3} \), \( \frac{3}{2} \). These numbers are reciprocals of each other. Have you seen an *hourglass*? The notion of reciprocals is like flipping it. The reciprocal of any real number and the number is 1. So to find the reciprocal of a number, we just think "hourglass" and flip it.

*J:* So what's the reciprocal of 7? What do we think?

*Jana:* Hourglass.

*J:* Yah, flip, the hourglass, remember?

Mathematics classrooms are filled with "rules" that are themselves functioning as signifiers for particular ways of speaking and doing mathematics. The tactic may, indeed, be to help students easily understand mathematical ideas, but the strategy - the unintended effect - is that mathematics is "really" about the correct application of the signifiers, and thus, mathematics as a preconstituted knowledge -- as a discourse of the
university -- is "sewn" with students' constitution as its subjects. The two sets of rules below which were posted on the chalkboards of Mr. Jack and Ms. Prahst (for at least two days) illustrate what I am arguing in the preceding sentences.

Ms. Prahst (Mathematical Modeling, January 12, 1998)

One-step equations: "undo" ; do the opposite
Two-step equations: "get rid" of all or subtract first
Distributive Property of equations: "get" rid of the parentheses
Three-step equations: get x's on one side, # on the other by adding and subtracting

****

Mr. Jack (Developmental Algebra A, January 21, 1998)

I Read problem
II Name variable(s), other facts
III (a) Write verbal expressions using variable(s) in Step II
   (b) Write in equation
IV Solve equation
V Proof: Check result in the wording of original problem

So perhaps the question, "What does it mean to solve a linear equation?" may actually mean: "What signifiers would enable one to solve a linear equation?" Notice the subtle displacement of thought and thinking. For the students, it matters less the significance and personal meanings that are attached to solving a linear equation than it is more about what signifiers are most dominant: "undo," "do," "get rid," "solve," "one-step equation,"
etc. The signifiers have, indeed, "stamped themselves" over students' subjectivities. A similar argument may be said about Mr. Jack's rules in the analysis of word problems. The question, "How does one solve an algebra word problem?" is reduced to: "What signifiers would enable one to solve a word problem?" The answers are all of the following (and there certainly are more): "read," "name," "variable," "write," "equation," "solve," "proof."

The problem, of course, begins the moment the signifiers are viewed as an end-in-itself and not as a means-towards. In fact, that was what actually transpired in most mathematics classes I observed. Students, and their teachers as well, without them realizing it, have already constituted their identities in the points de capiton of the signifiers. Furthermore, the teachers, inasmuch as they are drawn in the discourse of the university as its tool towards the production of mathematical knowledge, deploy subjectification through seemingly unproblematic signifiers that operate the discourse of school mathematics.

5.3 Power Axis: The Practice of Mathematics

Within the Foucauldian Context of Subjectification

(B)y truth I do not mean "the ensemble of truths which are to be discovered and accepted," but rather "the ensemble of rules according to which the true and the false are separated and specific effects of power attached to the true," it being understood also that it's a matter not of a battle "on behalf" of the truth, but of a battle about the status of truth and the economic and political role it plays.

Michel Foucault

Power/Knowledge

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5.3.1 **First, the Power of Mathematics.** From sections 5.1 and 5.2, I may have given the impression that mathematics students cannot escape the repressive power of mathematics because it is knowledge and that it operates through master signifiers that our society cannot do without. I must insist, however, that the power of mathematics, with an emphasis on the "power" part, is Foucauldian: it is a type of power that goes against the usual modernist concept of power that is situated within the "consent-coercion duality" (John Ransom, 1997, p. 15). It is against the explicit duality because it treads "between" the two terms. The usefulness of mathematics is beyond doubt. Typically, mathematics students consent to acquiring mathematical knowledge. But they are, in the same instance, coerced to the conventions and practices of mathematizing. Indeed, following Ransom, the power of mathematics, taken as a discipline in itself, is capable of normalizing, manufacturing individuals, and subjectifying them to particular modes of knowing which may and/or may not be repressive.

Which leads me to how Foucault employed the term *assujettissement*. Judith Butler (1997) claims that the term already involves a double process, that is, "the becoming of the subject and the process of subjection" (p. 83). The *becoming of the subject of mathematics* necessitates mathematics teachers' deployment of the discourses of the university and of the master. Once students' subjectivities are sewn to the discursive power of mathematics, to the rituals of conformity to mathematizing through the imposition of semantic markers in the imperative order (Paul Ernest, 1994, p. 160) -- that is, verbs that "order" such as *find, solve, compute* -- then students self-imprison themselves by participating in their own self-regulation. Thus, the process of subjection
begins. Like the prisoners in Foucault's *Discipline and Punish*, mathematics students desire to attain the norm, the standard, or the ideal. But this norm/standard/ideal has its roots not firmly planted in the subject of mathematics itself but in the symbolic order -- in the linguistic and social practices of the mathematics community, with the mathematics teacher serving an intermediary function. And that, of course, is problematic.

From Foucault, we learn that there is nothing wrong with the deployment of various tools of pedagogy if the goal is the transformation of the student as an epistemic subject. The tools become repressive -- and hence, problematic -- when the student becomes subject to the domination of the teachers' personal thoughts and actions, that is, the student is treated by the teacher as a pedagogical object rather than a pedagogical partner (Robert Young, 1994, pp. 86-88). For instance, mathematics teaches that fail to teach to devolution, whether or not the devolutioning occurs in a social milieu that is teachercentric, or teaches by imposition may have tendencies to curtail the development of students' "creative rationality" (*Ibid.*). Also, the teachers may be "abusing" power without them being fully aware of it. Consider the two episodes below:

**Episode 15.** (Mr. Taft's Developmental Algebra A Class) Students are discussing applications of linear equations.

*Mr. Taft:* In the table below, we're supposed to look for a pattern, find an equation, and determine the nth.

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Note the x values. We have 1, 2, 3, 4. So the difference is the same. So if we take the difference in the y, it tells us that whatever the difference is it goes in front of the x. (*Pause.*) Now, we have to adjust. So $y = 2x - 1$. So what's the 10th?

**********
Episode 16. (Mr. Taft's Developmental Algebra Class, December 9, 1997). Students are discussing applications of linear equations.

Mr. Taft: Given number 21: (2,10), (4, 20), (6, 30). So what's 20 minus 10?

Chase: 10.

Mr. Taft: What's 30 minus 20?

Chase: 10.

Mr. Taft: Okay we have constant differences in x and y. Now what's 10 divided by 2?

Chase: 5.

Mr. Taft: Okay so that's the number in front. So \( y = 5x \). (Pause.) Okay, number 22. He draws the following on the board:

Here initially we think of \( y = x \). Now using (5, 4), we have 4 = 5, and we need 1 less 5 to get 4. So then \( y = x - 1 \).

Next one, number 23. We're supposed to find the equation of:

<table>
<thead>
<tr>
<th>x</th>
<th>-20</th>
<th>-10</th>
<th>0</th>
<th>10</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>-35</td>
<td>-5</td>
<td>25</td>
<td>55</td>
<td>85</td>
</tr>
</tbody>
</table>

Mr. Taft: How far is 85 from 100?

Chase: 15.

Mr. Taft: From 100 to 115?

Chase: 15.

Mr. Taft: So this number 100 is in the?

Chase: Middle.

Mr. Taft: So x must be?

Chase: 25.
Mr. Taft: Number 28.

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>1.5</td>
<td>2.5</td>
<td>3.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Okay before you say it's not linear, you have 1, 1.5; 2, 2.5; 3, 3.5. So here you have $y = x$. So you started with 1 and ended with 1.5. So?

Chase: $y = x + 0.5$.

In Episode 15 above, while Mr. Taft had good intentions of instructing his students how to determine a general linear equation for a given set of ordered pairs, the strategic effect has been unintentionally produced. Students appeared to have failed to take ownership of the problem which already may have led them to view mathematical processes as being distinct from their own thought processes. In Episode 15 above, Mr. Taft's last three statements -- which are the main thinking parts in the analysis of the problem -- may have given students the impression that methods of analysis are "out there," and that it was up to them to produce the methods so that they fit with Mr. Taft's framework for analyzing problems. They may have understood the procedure but, certainly, they have failed to understand and generalize for themselves.

So subjectification in the situation above has undergone two processes. First, students became subjects of mathematics by their being acculturated to the signifiers that are unique to the analysis of linear equations (e.g., "difference" here stands for the coefficient of the linear $x$ variable obtained through differences in the $y$ values; "linear equation" takes the form $y = mx + b$). Second, the process of subjectification had Mr.
Taft acculturating his students to particular ways of analyzing problems of that type. But the process induced both tactic and strategies. While the tactic may have been about acquiring systematic methods of analysis, the strategies have been about "learning other people's method" and affirming Mr. Taft's status as "the authority" in mathematical learning. And when learning other people's method becomes for the student a matter of "thought dependence," then that is problematic because students learn not to think on their own and thus, they tend to devalue their self-roles in the construction of mathematical meanings. Episode 16 above illustrates how it is like for students to develop a kind of "dependence thinking" that is problematic and dangerous. Notice how the absence of devolutioning allowed Mr. Taft to illustrate different ways of analyzing linear equations that are given in different representational contexts. Notice, as well, how in a class with 13 students in it, only Chase (African American) responded to Mr. Taft's questions. Observe, too, the quality of his "mostly arithmetical" responses to the kinds of "thinking" questions Mr. Taft posed to his students.

5.3.2 Impersonal versus Relational Social Interactions in the Mathematics Classrooms: Troubling Teacher Performance and the Production of Obedient and Docile Subjects. In Chapter Four, I argued that mathematics teaching is gendered and claimed the following: both Ms. Prahst and Ms. Lynch tend to exhibit a relational mode of knowing while both Mr. Taft and Mr. Jack tend to be exhibit an impersonal mode of knowing. Their modes of knowing are then embedded in the way they deploy their pedagogical practices. It makes sense, at this stage, to give a more detailed descriptive-analytic account of the dyadic interactions that occur in their classrooms. I
identify modal social interactions in the mathematics classrooms and to trouble those that produce docile bodies. In what follows, I begin with an illustration of a relational approach which induces a positive form of power relations. The situations that follow thereafter deal with how an impersonal approach induces a strategic effect of control and monological authority.

Mathematics teachers who exhibit a relational mode of knowing and are successful in deploying a pedagogy that is relational tend to have social interactions that are reciprocal, interactive, and dialogical. Ms. Prahst, in particular, encourages students to talk about mathematics in their own terms and many students seem positively reinforced. Also, Ms. Prahst (and Ms. Lynch, too) frequently moves around the room and from table to table. This way, she anticipates students' questions (by "meeting" them where they are) and fulfills her need to personalize mathematics teaching. I find it interesting that among all the four teacher-participants, it was in Ms. Prahst's class where I seldom heard a student ask for a "pass" (an excuse slip to, say, go to the toilet). In the situation below, note that Ms. Prahst appears to have no control over the situation. The manner by which she asks the questions encourages her students to speak out more and take a dominant role in the interchange of ideas.

**Episode 17. (Ms. Prahst's (P) Mathematical Modeling Class, October 31, 1997)**

This is a follow-up activity. Students are using their calculators in exploring matrix operations.

**Ms. Prahst writes the following matrices on the board:**

\[
A = \begin{bmatrix} 3 & 8 \\ 4 & 5 \\ -6 & 2 \end{bmatrix}, \quad B = \begin{bmatrix} 1 & -1 & 7 & 9 \\ 3 & 2 & 5 & 1 \end{bmatrix}, \quad C = \begin{bmatrix} -3 & 0 & 2 & 6 \\ 4 & 5 & 1 & 5 \end{bmatrix}, \quad D = \begin{bmatrix} 2 & -3 & 5 & -4 \\ 1 & 3 & 6 & 0 \end{bmatrix}
\]

**P:** Which of the matrices there can we do something with?
Claire: B, C, and D.

P: Why is that, Claire?

Claire: All three of them are 2 x 4 matrices and we could add ‘em up.

P: Right. But is there something we can do with matrix A?

Jan: Yah. We can multiply it with another matrix.

P: And why can we do that?

Jan: Ahm matrix A’s 3 x 2, and if we take matrix B which is 2 x 4, then we can get a 3 x 4 matrix. The other matrices are also 2 x 4.

P: Tell me. If we multiply matrix A with 3, what do you think would we get?

Adrian: We can multiply each number there in the matrix by 3.

Ms. Prahst writes on the board:

\[
3 \cdot A = 3 \cdot \begin{bmatrix}
3 & 8 \\
4 & 5 \\
-6 & 2
\end{bmatrix} = \begin{bmatrix}
9 & 24 \\
12 & 15 \\
-18 & 6
\end{bmatrix}
\]

P: Now verify this using your calculator. Here we’re doing scalar multiplication. That means we’re scaling it three times.

Ms. Prahst gives the class about two minutes to accomplish the task.

P: All right, what can we do?

Jim: Well can we add |B| + |C| + |D| now?

P: Yah.

The class spends about five minutes accomplishing the task.

P: Now what can I not do over there?

Jim: |A| + |B|.

P: Why, Jim?

Jim: Well because one is 3 x 2 and the other’s 2 x 4. They don’t match up.

P: Do you mean the dimensions don’t match up.

Jim: Yah, it doesn’t make sense to just add ‘em up.

P: Okay. If you’re done, you can take a break and drink water.
Ms. Prahst then moves in the middle of the room and starts answering individual questions.

Studies on proximity and teacher movement in classrooms claim that "increased movement by teachers in the classrooms decreased inappropriate student behavior and increased the positive interactions of the teachers and their students" (Richard Shores, Philip Gunter, and Susan Jack, 1993, p. 97). In mathematics, at least, this finding seems to be dependent on the condition that a teacher (especially mathematics) knows how to teach in a coherent and organized manner. By "coherence" here, I mean the teacher is able to provide a systematic method in teaching a particular mathematical content and yet, takes into consideration and knows how to negotiate with existing classroom forces and realities that almost always influence the outcome of mathematizing. Interactions in Ms. Prahst's class tend to be informal and yet, directed and coherent because she seems to know her subject and her students well enough to appear both flexible and organized.

Ms. Lynch frequently moves around the room and from table to table but doing that does not seem to help decrease inappropriate student behavior in her classes. Students in Ms. Lynch's classes take turns in requesting a "pass;" students are all over the room; too little mathematizing occurs because unnecessary distractions always get in her way.

Mathematics teachers who exhibit an impersonal mode of knowing may tend to have social interactions that are more controlling and subtly coercive. In such classrooms does one witness the production of docile subjects. In Mr. Taft's classes, there is hardly any interaction. In Mr. Jack's classes, there is interaction but only in situations where students are asked to do boardwork. For both of these teachers, what matters is the efficient use of the class period for drill work; it is a time in which the "discipline of the
"minute" is fostered, valued, and deployed unproblematically. Foucault (1977) writes, 
"(T)he only truly important ceremony is that of exercise" (p. 137). Students are 
constantly subjected to "small acts of cunning" such as worksheet, homework, and 
boardwork until they are saturated and have exhibited efficiency in the application of 
correct rules and methods.

One very apparent difference between the male and female teacher-participants in 
this study is classroom movement. Mr. Taft and Mr. Jack did not circulate in the room 
during the ten-week observational period. Mr. Taft hardly has time to circulate because 
most of his time is spent lecturing, trying to cover an average of 25 problems in a given 
session. Even if he has extra time, he usually asks his students to work on their 
homework assignment on their own and unsupervised. Mr. Jack's usual routine (except 
perhaps in his afternoon geometry class) involves teaching for about thirty minutes and 
then spending the remaining time tinkering with his computer notebook (updating his 
records, recording grades, etc.) while the students either wait for the end bell or finish 
their homework on their own.

I seem to get the impression that 
"interaction and law-giving" closely mean 
the same thing for both male teachers.

Interactions tend to deal mainly with 
questions and clarifications about rules 
and operations. The episode below 
illustrates a typical interaction in Mr.  

**Episode 18. (Mr. Jack’s Algebra A**  
**Class, January 5, 1998)**

**Mr. Jack:** We've got to be proficient in 
solving linear equations.

Whether it's an old way or a 
new way, you've got to do 
this.
Mr. Jack: Okay, how about some volunteers? (Pause.)

Brian: I'll answer one, Mr. Jack.

Mr. Jack: Okay, Brian do this one.

Brian writes on the board: $8u = 6u + 14$.

Brian writes $-6u$ on both sides: $8u = 6u + 14$

Brian: So I subtract?

J: Yes.

Brian writes: $2u = 14$.

Brian: Then?

J: You want $u$ isolated.

Brian writes: Do $x$, undo $/$. 

Then Brian writes: $2u = 14$

J: No, divide.

Mr. Jack takes the chalk from Brian's hand and erases -2.

J: You need to draw a line here, like this:

\[
\begin{align*}
2u &= 14 \\
\hline
2u &= 14 \\
2 &= 2
\end{align*}
\]

and put the 2 down on both sides of the equation:

\[
\begin{align*}
2u &= 14 \\
\hline
2 &= 2 \\
\hline
u &= 7.
\end{align*}
\]

Witnessing Mr. Jack and Mr. Taft deploy their non/interactive pedagogical skills makes me think of Foucault's discourse on docile bodies. Both teachers foster a kind of
technical rationality by insisting that students do things the proper way, meaning to say, their way. They pay close attention to how they want their students to write their solutions and how equations ought to be solved. Test questions and examination instructions also tend to reinforce each teacher's particular methods of analysis, solution, and writing. Mr. Jack has, on several occasions, complained about students not knowing how to follow instructions and do as told (as has Ms. Lynch). A strategic effect is that teachers give the impression that mathematizing is about results and formal, determined processes (rather than personal). Students then constitute themselves by developing processual strategies that teachers value. Students may also perceive the idea that in mathematizing, the question of relevance and/or truth/falsity of mathematical processes may not be all that significant.

5.3.3 The School Mathematics Curriculum: The Art of Distribution, Ranking, and Normalization. At CHS there are two "tracks" of study: college prep math and noncollege prep math. The college prep math track consists of: Algebra 1, Algebra 2, Geometry, and Precalculus. The noncollege prep math track consists of: Developmental Algebra A, Algebra/Geometry B, and Mathematical Modeling C. It is not surprising and well known that urban schooling realities already anticipate students that may not be interested in pursuing college studies (hence, the label "noncollege bound"). According to Mr. Taft, students and their parents in CHS make the final decisions about the students' choice of track. Obvious Foucauldian questions emerge: Is the tactic of tracking and differentiation indeed necessary, what strategic effects are not openly expressed, and how are those strategies being deployed?
Ms. Lynch, students here seem more quiet than the last one.

Ms. Lynch: Well, the big guy’s not here. He’s at Peak. Two others who were weak were moved down to Algebra A. These guys that are left are doing real algebra¹.

*****

Mr. Taft: Not everybody can. Not everybody, at least the ones I have, is going to be successful in taking algebra. Not algebra algebra but watered down, milk run, whatever you wanna call it. Maybe they will, but the actual Algebra 1, the real, straightforward, hardcore Algebra 1, they don’t have the prereq because they haven’t had success with that. (Mr. Taft, first interview)

Ms. Lynch and Mr. Taft’s perceptions (which Mr. Jack shares as well) about the noncollege prep mathematics curriculum have implications about how such curriculum is being taught by them in CHS. The first strategic effect deals with how the teachers “actually” perceive the noncollege prep curriculum (which has a bearing on how they implement it). Called by many different derogatory terms, the noncollege prep math curriculum induces a kind of teaching that is “terminal” and apparently differentiating, cognitive-wise. Even if students in the noncollege track finish the sequence, according to Mr. Taft, they may still encounter difficulties in pursuing a college prep math track.

“They couldn’t. They just don’t have the background. I mean they’re just stuck,” Mr. Taft insists. This remark is problematic because it is contrary to one goal of the noncollege prep math track which is to provide a smooth transition to the college prep course Algebra 2. Mr. Taft’s comment below explains how noncollege prep mathematics content compares with the Algebra 1 of the college prep math track.

¹From my field notes; italics mine. Algebra 1, November 21, 1997. “Peak” is a detention hall for those students that are punished for misbehaving in class.
Two or maybe three-step process [in solving linear equations] and that will be it in Algebra A. There's no factoring, none of that that you get in Algebra 1 that you need in Algebra 2. (Mr. Taft, second interview)

A second strategic effect deals with what I refer to as double subjection particularly for students in the noncollege prep track. A first subjection points to the differentiated school mathematics curriculum which makes visible marked differences between the kind and depth of mathematics that students in each track are being exposed to. A content analysis of the two curriculum tracks is given in the Table 5.1. A second subjection is related to the low clientele perception that teachers carry with them as they implement the noncollege prep math curriculum. What is thus problematic stems from the version of mathematics that noncollege prep students get as resulting from the strategic effect of double subjection.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Noncollege Prep Track</th>
<th>College Prep Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patterns, Relations, and Functions</td>
<td>Basic precalculus concepts. Different representations of functions, variations, algebraic functions such as linear and quadratic functions except for rational and radical functions, transcendental functions. Trigonometric ratios and applications. Inductive reasoning (geometric). Procedural terminologies are emphasized. Technology is downplayed.</td>
<td>Precalculus concepts. Emphasis on the functions concept. All algebraic and transcendental functions are taken up, including absolute value and inverse functions. Sequence functions and conic sections are also discussed. Technical terminologies are emphasized and a technological approach to mathematizing is fully encouraged.</td>
</tr>
<tr>
<td>2. Problem Solving and Basic heuristics.</td>
<td>Different heuristics are</td>
<td>(Continued)</td>
</tr>
<tr>
<td>Topic</td>
<td>Noncollege Prep Track</td>
<td>College Prep Track</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Strategies</td>
<td>Problems taken up are mostly of linear type. No technological heuristic is to be taught. Representations include mostly paper-and-pencil based methods such as tables, graphing, sorting, drawing.</td>
<td>taught. Proofs include both inductive and deductive and algebraic (in trigonometric identities). Methods of proof encourage different approaches. Approximating and estimating solutions algebraically and using technology.</td>
</tr>
<tr>
<td>3. Number and Number Relationships</td>
<td>Comparison, basic arithmetical operations and estimations, absolute value, real numbers, scientific notation and operations, and basic operations involving radicals.</td>
<td>Conceptual approach to numbers and relationships: sets, properties. Real numbers and operations are explained in different representational contexts. Complex numbers and properties (includes proofs of the properties). Algebra and geometry of complex numbers. Interval notations, trigonometric numbers (special angular values), and polar coordinates.</td>
</tr>
<tr>
<td>4. Geometry</td>
<td>Kinds of lines, similar and congruent figures, properties of triangles and quadrilaterals, coordinate geometry, right triangle trigonometry, and laws of sines and cosines. Use deductive reasoning, basic geometric constructions and geometric transformations</td>
<td>Algebraic and geometric approaches to all kinds of lines, full treatise on conic sections and properties, laws of sines and cosines, odd and even functions, geometric transformations, finding trigonometric values of any angle, and a full course on trigonometry. Noneuclidean geometries and the axiomatic system. Triangles and quadrilaterals</td>
</tr>
</tbody>
</table>

(Continued)
<table>
<thead>
<tr>
<th>Topic</th>
<th>Noncollege Prep Track</th>
<th>College Prep Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Measurement</td>
<td>Use formulas to compute for interest, perimeter, volume, area, surface area of simple two and three dimensional figures. Circumference and areas of circles, Pythagorean theorem, trig ratios, estimation in measurements</td>
<td>Algebraic and geometric exercises involving areas, volumes, etc. of quadrilaterals and circles. Motion problems. Trigonometric equations, polygons and areas, application of transcendental functions to interest, loans, and annuities, scale drawings, extreme of graphs and spreadsheets, application of trigonometry, Pythagorean theorem and similar triangles in concrete situations. Heron’s formula, conversion of degrees and radians, vectors.</td>
</tr>
</tbody>
</table>
Table 5.1 Comparative Analysis of Course Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Noncollege Prep Track</th>
<th>College Prep Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measures of variability and averages</td>
<td>Binomial Theorem. Design and conduct experiments. Finite and infinite sequences and series</td>
<td></td>
</tr>
</tbody>
</table>

*The Social Construction of Mathematical Ability.* The notion of "mathematical ability" for the teachers in this study is far from the scientific definition. A student's mathematical ability is assessed through factors whose nature is linked with those taken-as-shared (and oftentimes, pernicious) normalizing practices in schooling. Some of these factors include: tracking based on elementary or prior grades; tracking by choice (versus tracking by force); a student's desire to do mathematics; a student's ability to accomplish assigned tasks on time, and; a student's ability to "follow" instructions and be "shaped" by her or his teacher's expectations, that is, ability that is marked by the teacher's image and perceptual biases of what the student could and could not do. Thus, a student's mathematical ability is a function of factors that do not really have to do anything at all with the “interior” (personal) qualities of the student but are related more to the impressions teachers make and develop as they deploy their pedagogic gaze in the classrooms.

Teachers' notion of what constitutes an ideal mathematics student is tied in a problematic way with what I perceive as "mathematically able" for them. Consider the interview excerpts below.
Ferdie: What for you makes an ideal math student? I mean what makes a good math student?

Mr. Jack: A student who comes everyday, who may run into barriers in terms of understanding but is focused and really makes a good effort and tries as hard as he can and do what he's supposed to do in class work and homework. They aren't the brightest kids but they work hard and I guess that means a lot to me 'coz they're doing what they're supposed to do.

Ms. Prahst: The normal who brings stuff to class and pay attention. ... I just they would just be willing to do work, just do whatever comes along. The ideal student ... just does the work, no matter what.

Mr. Taft: A self-motivated go-getter. Somebody who wants to know how to do the problem. ... Maybe [s/he] can get the problem whether [s/he] feels it's too difficult or it's taking too long. ... (A)nd not be put off or frustrated by incorrect solutions.

Ms. Lynch: Students would come in excited to do what they'll gonna do or what's planned for the day. ... They would actually be excited about what they're doing in their math class and actually stay focused on that problem.

Students' mathematical abilities, at least as reflected in the grades they obtain from their teachers' classes, are mainly a function of how much students' participation in the classroom deviate from each teacher-participant's personal conceptions of the ideal math student.

5.4 Summary

There is nothing innocent about teaching mathematics. While the nature of mathematics has been viewed, both by (poststructural) philosophers and mathematicians, as representing the ideal metaphysics, teaching it is far from ideal. It is political and surprisingly for some, subjective. More than anything else perhaps, teaching mathematics involves the construction of a student's math subjectivity which always
already stands in relation to an “objective-ized” (dehumanized) nature of school mathematics.

Mathematics teaching involves the deployment of various (conflicting) non/discursive acts which tend to influence the construction of students’ math subjectivities. The teacher-participants in this study are not simply performing their roles in the order of society. In this chapter, I unpack the specific, microfunctioning of a subjective economy of power of school mathematics as it is deployed by the teacher. In particular, sections 5.1 and 5.2, the knowledge axis and which dealt with the Lacanian discourses of the university and of the master, highlight the always already subjectifying power of knowledge and master signifiers that are the tools of knowledge. In another sense, the nature of school mathematics is already a tool of subjectification. Thus, the mathematics student is formed whose specificity is constructed through tactics and strategies that teachers deploy. In 5.1, I presented Episode 13 which illustrates how a particular pedagogical practice that is specific to mathematics tend to produce a particular kind of solver.

Section 5.3, the power axis, has been written to further enunciate the various non/discursive practices that the teacher-participants in this study tend to exhibit as perhaps resulting from their own hegemonic location. In this section, too, I extrapolated in detail the double process of subjectification -- the becoming of the subject and the process of subjectification. The “becoming of the subject” is affected by the hegemonic realities of the Lacanian discourses. The “process of subjectification,” on the other hand, is more closely functioning within teachers’ own practices. I also talked about some
possible consequences of tactics and strategies involved in teaching. I argued that a responsible, relational approach tends to reduce student passivity, while a controlled, subtly coercive impersonal approach is usually drawn to the pathological path. Students become passive and obedient subjects because "authority" is powerfully capable of shaping a student's subjectivity. Also in 5.3, I argued that specific to the urban situation, students that are in noncollege prep track courses may experience double subjection: first resulting from a differentiated program and second resulting from their teachers' perceptual biases. A content analysis of the school mathematics curriculum for college prep and noncollege prep tracks is also presented in Table 5.1. Finally, also in 5.3, I claimed that mathematical ability is a social construction.
I am suggesting that we take seriously the ideas on power put forth by Foucault and others. We may indeed be constituted subjects — not wholly autonomous agents. But we can at least exercise our critical intelligence to examine the possibility and to consider what we might do if we become convinced that many current arguments for reform are largely artifacts of the organizational drive for self-preservation. If we believe something like this, or even suspect that we have been influenced a bit along such lines, we might ask ourselves what alternatives might be feasible.

Nel Noddings

*Does Everybody Count? Reflections on Reforms in School Mathematics*

Research in mathematics education gains its relevance to practice or to further research by its power to cause us to stop and think. It equips us not with results we can apply but rather with tools for thinking about our work. It supplies concepts and techniques, not recipes.

Jeremy Kilpatrick

*Staking Claims*

In more ways than one, this ethnographic study responds to points raised in the 1986 *Research Agenda on Effective Mathematics Teaching*. In it, Thomas Good and Bruce Biddle (1986) suggest that, in order to avoid the "immediate already" demise of any reform initiative in school mathematics and the tendency towards simplistic framing
of the discourse on mathematics teaching, mathematics educators and researchers must seek to acquire "empirical information" about actual mathematics teaching in the classrooms (pp. 114-142). This ethnographic study is certainly among the most recent research on mathematics teacher culture at the (urban) secondary level. The rhizomatic framework used anticipates the multiplexity of a mathematics teacher’s workplace environment and culture, more generally. It reveals the teacher as acting in both determining and determined conditions, or in Foucauldian terms, panopticizing through the pedagogic gaze and panopticized in response to the inherent internal and external structures of school politics. I discuss the implications of the rhizome later in this essay.

Once again, we find ourselves in the midst of a restructuring in school mathematics education. In oversimplified terms, the "name of the father" is constructivism. Constructivism is a complex of theories of knowledge, of learning, and human development that is driven by a kind of hermeneutic thrust: individuals are subjective knowers and any objective reality is relative to the I/eye (Joe Kincheloe, 1993, p. 108). That being the case, the pedagogical relationship must be about cultivating the possibility of "many worlds." The structure of possibility is as follows: against discussion and monological authority that tend to produce received mathematics and docile students, conversation and negotiation lead to meaningful construction of mathematical meanings.

But romantic as the constructivist principles sounds, there is a certain silence in the constructivist text that perhaps only urban mathematics teachers are able to "read" as a result of their specificity and situatedness. Can one do constructivism in school
mathematics without the social, in which the social is constructed as a concept beyond the prison without walls of the urban classrooms, beyond the (social constructivist) (emergent)(interactionist) notion of the social? In a brilliant reflexive piece on reforms in school mathematics, Nel Noddings (1994) anticipates many of the un/spoken sentiments of the teacher-participants in this study: “Why do we insist on math for everyone?” (p. 89), “Should all of the students be compelled to take the same courses?” (p. 93), “What talents will go unnoticed and underdeveloped while [teachers] cram algebra and geometry into unwilling minds? What attitudes will [the teachers’] students develop toward work? What sense will they make of their world as a result of [the teacher’s] teaching?” (p. 93), “[Does] ‘(t)aking’ mathematics guarantee learning mathematics?” (p. 94).

Before I proceed with a summary of important points raised in each of the previous five chapters, I need to talk about both methodological and theoretical positions that I employed throughout this study (which actually took me two years to figure out). Methodologically speaking, this dissertation employs school ethnography. The ethnography deals with the lived experiences of four high school mathematics teachers in an urban setting. I obtained data mainly through interviews, document analysis, persistent observations, and the rhizomatic attitude of working not for or with the teacher-participants in this study but “between them.” Unlike modern ethnography, this work is poststructural ethnography in that it seeks a critical ontology of “how things are,” problematizing the acritical status quo of everyday ideas which Antonio Gramsci has referred to as “commonsense.” The commonsensical notion of the innocence of mathematics teaching is problematized. Recent reform rhetorics including the rhetoric of
the Standards with its promise of utopia and the rhetoric of meaningful (and authentic) 
learning of mathematics in the constructivist movement are (re)assessed vis-a-vis the 
constraints of urban mathematics teaching. The performance of resistance to 
mathematical knowledge by students in Copeland High School (which I suspect is a 
school phenomenon across many U.S. urban schools rather than an isolated instance) is of 
particular instance in this (re)assessment.

In this work, I highlight the structure of complexity of mathematics teachers' 
work and lives in an urban setting. I describe how the forces of the practicality ethic -- 
those "particular preconditions of teaching" (Judyth Sachs and Richard Smith, 1988, p. 
425) -- always and already influence the outcomes of the teaching of mathematics. 
Thomas Romberg's question, "Can teachers be professionals?" necessitates an 
ethnographic response; J. Shroyer's question, "What makes mathematics teaching 
difficult?" requires a careful analysis of classroom interactions from a rhizomatic 
perspective. Noddings's remark quoted at the beginning of this chapter when conjoined 
with the critical perspectives of Michel Foucault points to the need to frame a praxis of 
alternatives in order to move against the cult of self-preservation and constitution.

Underlying the theoretical position that I pursue in this work is the rhizome, a 
concept that expands a Heideggerian meditative thinking about social phenomenon. 
Meditative thinking, according to Martin Heidegger, requires an openness towards the 
phenomenon and to the mystery of incompleteness. The purpose of the rhizomatic map 
that I explore in this work is explained with/in the context of two thoughts that 
mathematics educator Jeremy Kilpatrick (1995) raised about research in mathematics
education in a very interesting journal article, *Staking Claims* (1995). Of Kilpatrick’s (1995) many points, I find two to be significant in my own work. Kilpatrick encourages mathematics educators/researchers to explore multiple methods, approaches, paradigms, epistemologies, and means of representation because no single research can ever “tell the whole story” (p. 24). But the most telling point Kilpatrick brings to bear deals with the power of research to “cause us to stop and think” (p. 25). Research must equip us “with tools for thinking about our work” and supply us with “concepts and techniques, not recipes” (p. 25). The concepts and techniques may encourage readers to ask more questions. In a similar vein, Paolo Freire aligns with critical pedagogue Antonio Faundez when Faundez claims that:

> the value of a thesis lies in discovering and formulating basic questions which will arouse the curiosity of other research workers. *The value lies not so much in the answers, because the answers are definitely provisional, as in the questions.* (Faundez in Paolo Freire and Faundez, 1989, p. 39, italics mine)

And, following Noddings’s (1994; see quote above) admonition to ask ourselves what alternatives might be feasible, the concepts and questions uncovered here may help *unskin* (Dennis Sumara and Brent Davis, 1998) the unquestioned regimes of pedagogy and of truth and foster the Foucauldian limit attitude: a poststructural attitude that seeks to know what and how we are in the order of things, that is, in the *episteme* — “the totality of relations” (Michel Foucault, 1972, p. 191; see Chapter 1) -- with the purpose of framing new(er) alternatives through further experimentation, that is, *moving beyond the limits.*
When I wrote Chapters One and Two, I had in mind Heidegger’s notion of meditative thinking. I have found Gilles Deleuze and Felix Guattari’s *rhizome* to be a “concrete” tool that has made it possible for me to actualize this kind of thinking. John Landau (1997) captures the metaphorical significance of the rhizome: disjunctive syntheses, hybrid discourses without being reduced to a single, unifying discourse. Deleuze and Guattari (1987) write, “a rhizome is not amenable to any structural or generative model. It is a stranger to any idea of genetic axis or deep structure” (p. 12). The strength of a rhizomatic framework lies in its (pre)condition towards fragmentation: it is heterogenous, it opens up multiplicities, multiple paths and entryways, and can and must “be connected to anything other” (Deleuze and Guattari, 1987, p. 7). The graphical representation of the rhizomatic framework used in this study (see Figure 2.4, p. 51), for instance, has a teacher-participant’s regime of truth disjunctively synthesized with many factors such as the social context of teaching, personal epistemologies of the teacher/knowledges, beliefs/attitudes, and practices, the meta-revolutionary changes (and often implicit) that occur in school mathematics, and both psychoanalytic and Foucauldian readings of the discourse of mathematics teaching (i.e., the implications of its deployment). There are more, of course, for the rhizome operates within an ( . . . and + and + and + . . . ) frame. The rhizomatic framework also anticipates questions such as: How does one analyze mathematics teaching beliefs and practices without considering the externalities of schooling? How come mathematics teachers are resisting constructivism, if constructivism has the potential to empower individuals and teachers to make mathematical teaching and learning meaningful?
I have found the rhizomatic framework useful in constructing provisional findings and interpretive analyses to the following research questions that guide this dissertation:

(1) What does it mean to teach high school mathematics in an urban setting at the present time? Specifically: How do mathematics teachers' personal epistemologies/knowledges, practices, beliefs, attitudes, and previous mathematical experiences or prior mathematical knowledges act on the way they teach mathematics in the classrooms? What kind of mathematizing do they practice? In what ways do the social context of mathematics teaching and certain conditions of existence impose their limitations on classroom practices and curriculum innovation?

(2) To what extent do pedagogical practices subjectify students into a way of thinking about/acting/doing mathematics in the classrooms? Specifically: In what way/s may these practices affect the way students learn mathematics? In what way/s may these practices affect the evolution of mathematical ideas in the classroom?

The motivation for the framing of the two research questions above is extrapolated in detail in Chapter One.

Chapter Two starts with a discussion on the meaning of the rhizome and ends provisionally with the implications of the various Deleuzean lines that make up our (lack-of-)being. Deleuze writes, "we are made up of lines and these lines are very varied in nature" (Deleuze and Claire Parnet, 1987, p. 124). I explain the lines in the context of
this dissertation. There are the unproblematized lines of segmentarity: the clearly, defined segments that induce a moving, not a becoming, but simply a passing through a segmentary. A mathematics teacher is first and foremost a mathematics student. Those segmentary lines that are “mapped” (versus “traced,” see p. 22-23) in a mathematics teacher’s practical and discursive consciousness actually allow her or him to deploy the selective tradition of school mathematics unproblematically. Training in mathematizing has always involved binaristic thinking such as right/wrong solutions. But the segmentary lines are defined in the symbolic order, in particular, through the institutionalized values that the mathematics and mathematics teacher education communities subscribe to. In the last fifteen years or so, the constructivist reform movement has played a significant, “influential” role in marking the characteristics of these segmentary lines. Unfortunately, segmentary lines are overcoded “in-between.”

The lines that make up a mathematics teacher have somehow evolved from an overcoding, abstract machine which, according to Deleuze, regulates the conformist practices. Not a few secondary mathematics teachers, for instance, “take it as shared” the following mathematical identities: Math 9 -- Algebra 1, Math 10 -- Algebra 2, Math 11 -- Geometry, and Math 12 -- Precalculus.

Then, there are the lines of becomings -- less rigid but more pliant and supple than the lines of segmentarity -- that induce a becoming. These lines take into account those factors that are not accounted for by the segmentary lines. There are the lines of norms (for e.g., teaching mathematics as a form of technological filter (Suzanne Damarin, 1997; Sue Johnston, 1991), lines of subjectification (for e.g., teaching mathematics within the
discourses of university and of the master (see sections 5.1 and 5.2), lines of conditions of existence (factors in the social context of teaching mathematics), and so on. Finally, there are the lines of flight (described briefly in footnote #2, Chapter Two; for e.g., teaching mathematics from a relational perspective) that appear as transgressions, more like lines of transversals in the geometric sense. These lines do something new, different, and are as dynamic as they are alive.

The rhizomatic framework is also discussed in Chapter Two. The framework consists of the following parts: (1) a temporal forgetfulness of ideology in favor of discourse; (2) an understanding of the mechanics of pedagogical power relations through Foucauldian genealogy; (3) a specification of various techniques of subject(ificat)ion using Jennifer Gore’s model; (4) Judyth Sachs and Richard Smith’s model of teacher culture, and; (5) a sub-rhizomatic analysis of a mathematics teacher’s epistemology, beliefs, and practices using several sources: Robert Young’s study on teacher epistemologies; mathematics teachers’ knowledge model advanced by Elizabeth Fennema and Megan Franke; Alba Thompson’s analytic model on teacher beliefs; Sherry Ortner’s anthropological theory of practices; Paul Ernest’s model that relates a mathematics teacher’s beliefs and practices.

Clusters (4) and (5) above are rather straightforward. A brief discussion of clusters (1), (2), and (3) is in order. Discourse is more dynamic than ideology because effects of discourse produce both hegemonic and counterhegemonic positions (or in Foucauldian terms, power relations are both repressive and productive/ transgressive). Also, following Kevin Heller, I make a distinction between tactics and strategies, that is,
the intentional acts and the unintended (but still institutionally and socially regularized) effects of human actions, respectively, as well as the discursive and nondiscursive characteristics of a genealogical discourse. What are officially written and spoken (discursive elements) may be different from how they are deployed (nondiscursive elements). For instance, the noncollege prep math track in Copeland High School is framed with good intentions (thus, a tactic), but the mode of pedagogical deployment induces a kind of double subjection (thus, a strategy; see section 5.3).

Foucault’s genealogy begins with the assumption that a problem exists in the present, and that a way to understand the problem is to be concerned with not what truths are spoken but what ensemble of rules define the truths (i.e., discursive formations or Gore’s regime of pedagogy). A Foucauldian genealogy, then, deals with both tactics and strategies of power and power relations. Judith Butler’s reading of Foucault’s notion of subjectification involves the dyadic process of subordination and forming of the subject. Butler claims that much of Foucault’s work leaves out the specific mechanisms or technologies of subjectification. Which explains why I found Gore’s model very useful. Making Foucault more explicit, Gore identifies several techniques of subjectification, derived from Foucault’s various works, namely: surveillance, normalization, exclusion, distribution, classification, and individualization.

Chapter Three consists of two sections. I make a first assertion that, following Trinh Minh-ha, we can never come face to face once and for all with the objects of our interest. Again, Minh-ha’s comment appears compatible with Heidegger’s meditative thinking. But then I argue, following Richard Rorty, Jacques Lacan, and Herbert Blumer:
the world is out there, there is a "real" that resists and talks back. Which leads me to define methodology, following Blumer, as consisting of principles that underlie and guide the full process of studying the obdurate character of the empirical world that comprise my study. Then, I describe poststructural ethnography as being both modern (in the conventional sense) and political/postmodern (in the critical sense). Here I relate the problems I have in speaking for and about others in this research. Since the postmodern turn in the social sciences involves a return to subjectivities, I define poststructural ethnography and the way to transvalidate many of my claims through (self-)reflexivity.

Also, following Renato Rosaldo, I insist that all my interpretations -- through the statements I make that are neither propositions nor utterances (Foucault, 1972) -- are provisional: my own positionalities and choices allow me to know certain things and not others, and my analyses are always incomplete.

The second section of Chapter Three is a dialogue with my self about the politics of research ethics and validity. I talk about the learnings I obtained as I construct and describe how I put into action the different techniques in collecting and analyzing ethnographic data. Data reporting involves two steps: the construction of individual case studies and then a realist reporting across cases of important, sensitizing concepts (for e.g., round robin absentees, privatism or a teacher’s sense of isolation). In the data analysis, I followed some suggestions made by Michael Patton. I use sensitizing, analyst-constructed, and theory-driven concepts. Chapter Four includes both sensitizing and analyst-constructed concepts; Chapter Five illustrates theory-driven concepts. Following Roger Simon and Donald Dippo, I also insist that most ethnographic data is
I end Chapter Three with the thought that this dissertation moves beyond and over the divide of generating/testing hypotheses. Against educational positivism in which the paradigmatic desire is the “irrational pursuit [of] quantify[ing] all aspects of human belief and experience” (Ray Rist, 1972, p. xiv), Michael Hammersley and Paul Atkinson articulate very well my intentions: “the search for universal laws is rejected in favor of detailed descriptions of the concrete experience of life within a particular culture and of the social rules or patterns that constitute it” (quoted in Edward Scott and Robin Usher, 1996, p. 143).

Chapter Four responds to Dissertation Research Question 1. The aside in Chapter Four is a deconstructive exercise in two parts: a reversal is first performed, illustrative justifications are provided, and then a displacement is made towards the end of the aside. Judyth Sachs and Richard Smith, in agreement with John Goodlad and Basil Bernstein, argue that teacher culture is uniform and same, no matter the location and the type of ideology that it is situated within/against. I argue, based on my own research findings, and along with Ann Lieberman, Susan Stodolsky, Paul Cobb, Erna Yackel and Terry Wood, Stieg Mellin-Olsen, and the Boston Women Teacher’s Group, that a mathematics teacher’s work and culture, in general and in its multiplexity, is wed to a plurality of competing factors and changing -- thus, unstable -- contexts that redound from the various contradictions, conflicts, assimilated contraries, and double binds that a teacher negotiates daily in classrooms and the larger work environment. In section 5.1, I claim the social context of secondary urban mathematics teaching makes it difficult for the teacher-participants in this study to implement change and recommendations from the
reform movement. In particular, the phenomenon of *round robin absentees* has the following effects: (1) it affects what mathematics is or can be taught as well as how it is or could be taught; (2) it makes it difficult to establish continuity and depth in mathematical knowing; (3) it makes it almost impossible for the teachers to cover the recommended school math curriculum with the depth that is needed to strengthen the students' conceptual foundations; (4) it is incompatible with the highly-ordered pre-structured nature of school mathematics so much that it becomes a burden for the teachers to implement an "algebra or geometry for everyone;" (5) there is time wasted by the necessity of repetition, and; (6) there is difficulty in implementing pedagogical innovation. Personal experiences and the constitutive elements that operate with practical and discursive consciousness limit the coping strategies that a teacher might employ.

Also, as shown in Chapter Four, the ethos of mathematics teaching and the new ethos of schooling appear to be in conflict. In section 4.2, I claim that while the ethos of schooling has changed, the nature of school mathematics and the mathematical tasks that are deployed in the classrooms have remained unchanged and thus, stable. Some implications of this conflict include: (1) teachers tend to perceive the students and their parents as lacking of interest and commitment toward the subject of mathematics; (2) teachers perceive some students as apathetic and resistant to learning mathematical content; (3) teachers perceive some students as coming to school with little or no desire to learn; (4) teachers fail to cultivate the significance their students give to their input, and; (4) teachers view students, parents, and the wider society as being disrespectful to the school as a workplace. For the teachers, such disrespect implies that the families and
the wider society devalue the role of mathematics in the education of the young. In response, teachers tend to construct their own behavior as they find it to be appropriate to this context; their perceptions of appropriate activity in the classrooms are based on the characteristics they perceive in their students. This has consequential effects on a student’s initiation and acculturation into mathematics. The teacher-participants’ (except perhaps for Ms. Prahst) low clientele perception has, in fact, led to the understressing (and underestimation) of their students’ mathematical power and the students’ need for devolution. In this regard, it certainly is interesting to juxtapose the four teacher-participants’ united belief that the school mathematics curriculum does not revolve around their students’ interests and background.

One effect of this conflictual situation is the teacher’s cultivation of a sense of isolationism. Isolationism is also conditioned by the incohesiveness of the mathematics department in Copeland High School. The mathematics teachers seldom meet as a department, and they are not obliged to work as a team. Logistics and scheduling also affect the amount of collaboration that takes place. Lack of support and collaboration from parents and the immediate society also force each teacher to become self-accountable for classroom decisions. Because the teachers do little or no collaboration, each performing in isolation, they (except, perhaps, for Ms. Prahst) tend to over-rely on their textbooks as their main source of pedagogical information.

The first two sections of Chapter Four illustrate a kind of analysis that Patton has referred to as “sensitizing concepts.” This analytic reading is still treading very closely with data; it is still working within a “realist tale.” This kind of analysis is of the first
order: it is "making the obvious obvious." In the remaining three sections, I deal with analyst-constructed concepts. This kind of (inductive) analysis is of a second order: it is "making the hidden obvious." In section 4.2, I claim that a mathematics teacher that lacks prior meaningful mathematical experiences or possesses a narrow experiential epistemology tends to constrain the meaningfulness of mathematical learning and teaching. The significance of controlling students in the math classrooms is related to the value of control that is derived from Western mathematics, according to Alan Bishop. Also in section 4.2, I explain in detail the ways this research reflects constructs contributing to the gendered nature of mathematics teaching. I insist that gender labels are not absolute but are useful. Table 6.1 compares mathematics teacher characteristics with either relational or impersonal modes of epistemology. The section ends with some possible implications of a mathematics teacher's personal experiences vis-a-vis the two modes of knowing.

In section 4.3, I deal with in/consistencies between a mathematics teacher's espoused theories (about beliefs, attitudes, and practices) and that teacher's theories-in-use. Here I rely on Alba Thompson's reading of Thomas Green's belief systems as consisting of one or more of the following pairs: (primary, central), (derivative, central), (primary, peripheral), and (derivative, peripheral). Also, I use Ernest's model (see Figure 2.2) wherein he claims that the social context of teaching serves as the mediating difference between espoused and enacted theories and beliefs. In this section, I claim the following: (1) Ms. Lynch has consistently espoused and enacted theories and beliefs because both her views of mathematics and the social context
“equally” influence the way she teaches mathematics; (2) Ms. Prahst has consistently espoused and enacted theories and beliefs because she seems to possess a “dynamic,” evolving view of the nature of mathematics and she does not allow herself to be

<table>
<thead>
<tr>
<th>Relational Teaching</th>
<th>Impersonal Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caring and personal</td>
<td>Promotes individualistic (highly independent) thinking</td>
</tr>
<tr>
<td>Teaching in the we-relation with others, inserting themselves in the process</td>
<td>Teaching in the I-relation with others</td>
</tr>
<tr>
<td>Negotiation of mathematical meanings occur through interactive dialogue and through conversation (a merging of subjectivities)</td>
<td>Negotiation of mathematical meanings occur through monological lecture and through discussion (an analytical rhetorical structure)</td>
</tr>
<tr>
<td>It is connected teaching.</td>
<td>Fosters autonomous, objective, and rational mode of knowing.</td>
</tr>
<tr>
<td>It is characterized by attachment and connection: it is a type of connected, subjective mode of knowing in which knower and known are interlocked so tightly that the quality and meaningfulness of knowing, while interpersonally situated, occur in a deep, intrapersonal level</td>
<td>Knowing is characterized by attachment and connection: it is a type of connected, subjective mode of knowing in which knower and known are interlocked so tightly that the quality and meaningfulness of knowing, while interpersonally situated, occur in a deep, intrapersonal level</td>
</tr>
<tr>
<td>Knowing is a way of feeling in its own right.</td>
<td>Knowing is equated with methods, that is, knowledge is viewed as a product of correct rituals of the scientific method and the common-sense ideas of pupils are pushed aside.</td>
</tr>
<tr>
<td>Knower and the object of knowing (known) are simultaneously performing (i.e., Constructivist)</td>
<td>Knower and the objects being known are separate (i.e., Cartesian); the known is external to the knower, and process is other people’s process</td>
</tr>
<tr>
<td>Teaching allows devolutioning to occur and thus, transforming learners from “mere students” into “epistemic subjects”</td>
<td>Devolution is taken for granted</td>
</tr>
<tr>
<td>Teaching by negotiation</td>
<td>Teaching by “transmission”</td>
</tr>
</tbody>
</table>

Table 6.1 Relational Versus Impersonal Modes of Mathematics Teaching
determined by the (local) social context of teaching; (3) Mr. Jack manifests
inconsistencies between his espoused and enacted theories and beliefs because he tends to
become overwhelmed with the social realities of classroom life and mathematics
teaching, and; (4) Mr. Taft has consistently espoused and enacted theories and beliefs
because he tries to ignore the social realities of classroom life, although the consistency
must be read vis-a-vis Mr. Taft's impersonal mode of teaching mathematics.

Section 4.4 is an "interruptive" rereading of subtexts of the teacher-participants'
constructed "realities." Once more, I talk about the following: student resistance, the
social reality of school mathematics, an issue I have with Ms. Prahst regarding the
deployment of "poisonous pedagogy," the teacher-participants' confusion between
mathematical knowing and mathematical knowledge, the issue of prerequisite knowledge
in school mathematics, the issue of labels, textbooks and changes in content, an issue I
have with Mr. Taft concerning his belief that mathematics is interpretation-free, and the
significance of strain theory in teachers' practices.

Chapter Five responds to Dissertation Research Question 2. "Making the hidden
even more obvious," the ideas I draw from my analysis of specific classroom situations
are theory-driven. Again, I start with an aside which is purposeful because it maps out a
definition of subjectivity, a very difficult concept to grapple with. The aside is a long
prefatory essay, combining theory and illustrations drawn from this research. I start out
with the implications of the phrase "subject of discourse," based on two different
readings: psychoanalytic and poststructuralist. Then, I explain the significance of the
death of the subject: it is death from a particular kind of subjectivity, that is, Cartesian.

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The Cartesian subject as an autonomous, self-generator of meanings has dissolved. For Jacques Lacan, according to Marshall Alcorn, the radical decentering of the subject leads to a simultaneous rethinking of the subject's position in a discourse and using discourse to reposition the subject. I understand this Lacanian move as aligning closely with Foucault's perspective on the subject as being capable of resistance. In other words, the dynamic frame of discourse enables the production of both hegemonic and counterhegemonic discourses. The aside ends with what I believe to be by far the "most sufficient" and dynamic definition of subjectivity, that is, subjectivity is an individualized process of subject functions that, under particular conditions, alter, select, and symptomatically enscript the discourse of the larger world of social interaction.

A good response to Research Question 2 is genealogical in Foucault's sense. Hubert Dreyfus and Paul Rabinow (1983) describes a Foucauldian genealogist as "a diagnostician who concentrates on the relations of power, knowledge, and the body in modern society" (p. 105). Recall Butler's meaning of subjectification as consisting of the process of subordination and the formation of the subject. In sections 5.1 and 5.2, which I refer to as my knowledge axis, I discuss Lacan's discourse of the university and of the master, respectively, which respond to the first of the dyadic processes -- the process of subordination. The second of the dyadic processes -- the forming of the subject -- is explained in section 5.3, the power axis, and is treated in Foucauldian terms, that is, in terms of power relations. The discourse of the university highlights the value society accords knowledge. Employing a document analysis of specific statements in the Curriculum and Evaluation Standards (1989) and the Professional Standards for
Teaching Mathematics (1991) and an analysis of a few classroom situations drawn from my own work, I claim that mathematics teaching in Copeland High School is being deployed mainly as a tool in the production of knowledge, that is, school mathematics is being taken as an end in itself rather than as a means to benefit either individual subjects or the wider society. The lecture method and the primary concern with procedures in the mathematics classrooms condition students to accommodate without assimilation because procedures are mythically viewed as certain, stable, and time-tested. In other words, there is a tendency for mathematics teaching to push aside students’ own situated thinking in favor of knowledge. The discourse of the master is mainly about the impact of the master signifiers that characterize school mathematics. Science, according to Lacan, claims to be concerned with an understanding of the real via the empirical method. But Lacan insists that science, too, effectively functions to promote the various master signifiers that dominate it. Again, using math classroom situations, the teacher-participants have a tendency to put a premium on the master signifiers. Drawing on my ethnographic experience as the main source of transvalidation, I claim that mathematical understanding in these classrooms is confused with the mastery of the master signifiers, that is, the rules replace mathematical understanding. The master signifiers came to be viewed as ends-in-themselves, not as means-toward a meaningful understanding of mathematical concepts. Notice, too, the verbs that are in use in all mathematics textbooks: they are of the imperative order. Students, thus, “quilt” their mathematical identities (points de capiton) in the signifiers of mathematics, in the discursive power of mathematics, and in the rituals of conformity of mathematizing.
through the semantic markers. Hence, the process of subjectification is performed and the process of subjection begins (see section 5.2). Mathematics students, constituted by the mimetic tradition (learning by imitation), desire to attain the norm, the standard, the ideal. But the norm/standard/ideal has its roots not firmly planted in the subject of mathematics but in the symbolic order — in the linguistic and social practices that are deployed in the person of the mathematics teacher, who happens to deploy a kind of teaching that involves both tactics (discursive; the explicit rules) and strategies (nondiscursive; the implicit rules). I illustrate this simultaneously performing dyadic process of subjectification in various classroom interactions.

In terms of the kinds of behavior teacher-participants exhibit, classroom interactions also contribute to a student’s math subjectivity. I claim that a classroom in which the relational mode of knowing is most dominant tend to have interactions that are reciprocal, interactive, and dialogical. On the other hand, a classroom in which the impersonal mode of knowing is most dominant tends to have interactions that are more controlling and subtly coercive; here, teaching is like a “law-giving” session: what is fostered is a kind of technical rationality in which students do things their teacher’s way. Again, I explain this in the context of findings drawn from my own classroom observations.

The school mathematics curriculum is the best example we have of the art of distribution, ranking, and normalization. Here I do not deal with the truth of tracking, but with its tactics and strategies that are often taken for granted. I have as my focus the noncollege prep curriculum. I talk about the strategic implications of double subjection.
and the teacher-participants’ un/articulated perceptions which have strategic implications for how they implement the curriculum in their classes. Finally, I claim that mathematical ability for the teacher-participants is not defined using some “objective criteria” but is more a product of their own constructions of what defines an ideal, mathematics student.

*Back to the Rhizome*

One effect of the rhizomatic framework is that it opens up contradictory positions. In some parts of this work, I appear very sympathetic to the teacher-participants. But in some other parts, my reading appears very critical of their work and beliefs. I think this is a consequence of the rhizome (and the poststructural ethnographic discourse, *lest I forget!*) because the rhizoming process does away with privileged directions (but the connotations of my words remain). Zygmunt Bauman (1992) writes of the rhizome as “expanding sideways, upwards and backwards with the same frequency and without detectible regularity which would enable a prediction of the next move” (p. 27). As it ought to be in the first place, the structure of complexity of the ethos of secondary school mathematics teaching is as rhizomatically complex as the nature of the urban setting in which this teaching is located.

*I always speak the truth; not the whole truth, because there’s no way to say it all. Saying all the truth is literally impossible: words fail. Yet it’s this very impossibility that truth holds on to the real.*

*Jacques Lacan*

*Television*

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APPENDIX A

MS. LYNCH, MS. PRAHST, MR. JACK, AND MR. TAFT:
THEIR KNOWLEDGE, THEIR BELIEFS, AND THEIR ATTITUDES:
A "REALIST" TALE

(S)chools as institutions create contradictory feelings and
demand contradictory actions from teachers. The rhetoric
surrounding the institution of public education often
proves to be in direct conflict with the function a teacher
finds herself required to perform.

Boston Women's Teachers Group
Teaching: An Imperilled "Profession"

But it is more valid to point the finger at a powerful
purpose for schooling that is at core antieducational. By
structuring school around the goal of social mobility,
Americans have succeeded in producing students who are
well schooled and poorly educated. The system teaches
them to master the forms and not the content.

David Labaree
How to Succeed in School
Without Really Learning

ASIDE: Briefly ... A Realist Tale

What follows is data I obtained from the interviews I conducted with all the four
teacher-participants in this study. Data from observations are simultaneously reported
and analyzed in Chapters Five and Six. Presented in a form of a realist tale that John Van
Maanen (1988) characterizes as "the native's point of view," I desire to Van Maanen's
(1988) concept of a realist tale the Barthesian notion of a writerly text (versus a readerly
In other terms, I present a writerly text set within the tone of a realist tale. A readerly text is simply a (vertical) reading of a work; a writerly text, on the other hand, necessitates an active participatory reading with the intent of rewriting the text, with readers producing their own meanings of "remarks transcribed straight from the horse's mouth" (Van Maanen, 1988, p. 49). Not a few ideas raised by the teacher-participants themselves appear redundant. There are ideas, too, that may appear to be in conflict with each other, and yes, that has a purpose. Robert Emerson, Rachel Fretz, and Linda Shaw (1995) insist that the "task of the ethnographer is not to determine 'the truth' but to reveal the multiple truths apparent in others' lives" (p. 3), and this is what I set out to do in this chapter. A last Parthian shot: I want whatever initial interpretations to come "not out of my mouth (or pen), but from the natives themselves" (Van Maanen, 1988, p. 66).

Introduction: Student Culture at Copeland High School

Student Population. Copeland High School (CHS) is an urban public school in a growing mid-Western state and has a student population of a little over 1000. There are approximately 65% African-American students, 1 to 2% Asian-Americans (Chinese, Vietnamese, and Indonesians), about 1% Hispanic-Americans, and the rest are Caucasian-Americans. According to Ms. Walters, counselor for seniors at CHS, "we have quite a bit more than half the population is on free reduced lunch."

Parents. There is "minimal parental involvement," Ms. Walters claims.

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1 See Roland Barthes' (1972) Critical Essays.
2 I drew much data on parents and student culture at CHS from Ms. Walters (pseudonym), Caucasian-American. The interview was mainly clarificatory in nature. Some of her responses complemented my impressions which form part of data obtained from my journal.
Having been a senior guidance counselor for many years when I called on parents to advise them that their children are failing classes and might not graduate, some of them weren't aware of that. They didn't see a report card all year which to me is very minimal parental involvement. Even ask to see the report card, they didn't do that or the kids would get to the mail and take the mail before the parents could see news from school.

Many parents she would talk to often complain about how difficult it is to discipline their children. She says:

A lot of them basically wring their hands and say, "I can't control 'em anymore." And they don't try to do it. So that's a real problem for us because ... a lot of the kids move out when they get to be 17 or 18, or the parents have lost control real early and obviously you can't force a 16 year old if they have no respect or sense of family value. So I think it's a problem and you can, when you look at the successful kids, most of them do have parents who come to their games, who come to the open houses, who come to the parent conference days. A lot of kids don't have that.

Ms. Walters further argues that there are other parents that say they are interested in helping their children, but they tend not to "do the actions that we think are necessary to truly be interested." She notes that when there are open houses, fewer than 200 out of 1000 students "have their report cards picked up," which for her is indicative of parents' lack of involvement in their children's learning.

Ms. Walters also sees a problem when parents are not college educated themselves. These parents tend "not to push their kids" to succeed because if their kids go on to college and have a much better life than they were able to provide, th(eir) [kids] may leave [them]. That the children may separate emotionally as well as physically from their parents because they are now successful, they are earning money, [while] the parents are still living in the welfare housing or whatever.
Student Attitudes. With respect to the mathematics proficiency test required for graduation, CHS students' performance are similar to that of students in other big city schools in America. Although Ms. Walters thinks that there is still much the school needs to do and to think about insofar as the math proficiency test matters. "We still have 20 to 30 seniors over here that need to pass that test."

Generally, students at Copeland High like to play "get-by" games, Ms. Walters insists.

If they could get by with as little as possible, they will get by with as little as possible and most of them don't realize the ramifications of that 'coz they get either into high school or those who think they want to go to college don't have the foundation that they need.

Further, she claims that some students, because they know they only need two math credits to graduate, do not "see any personal worth in doing well at math." Students' attitude towards learning is confined only to what they would need to graduate high school. Students often argue with her and say, "Let me get by with my two math credits."

She also observes that students at CHS do not value homework in mathematics as she thinks they should if they want to have a strong college prep mathematical foundation. This observation stems from her own experience with her daughter with whom Ms. Walters compared students at CHS:

(H)aving observed my daughter taking precalculus at the same time some students here were taking [it], I knew she was at home at night doing 10 to 20 major problems, and the kids here would be assigned maybe four, five problems to do. So I suspect on one hand, the teacher couldn't assign more because ... students would not do it. So they're trying to get a balance between meeting the needs, meeting what the students are willing to do and knowing that there's more that they have to do to compete in the larger academic community or college. So it's very frustrating for the teachers to
want to give more and not have an audience who's gonna receive it.

Having been in the classrooms myself, I think mathematics teachers give too many homework problems to do. Three of my teacher-participants employ the typical, traditional practice of making assignments through the collective numbering system (e.g., asking students to do numbers 1-15 and 18-35 in a short period of time). But I also agree with Ms. Walters that even if teachers reduce the homework load (like the practice of Ms. Prahst who assigns representative items), many students still will not (want to) do them.

Here at CHS, all the teacher-participants in this study always deal with students that are simply resisting the task of doing their homework in mathematics. Ms. Walters is not sure if it is limited to mathematics alone. She thinks students imbibe the "get-by" attitude:

One of my biggest frustrations is ... the "get-by" attitude. If you can get by with a D, "Okay, I'll get my credit. I may get my diploma. I'm gonna get by. I'm not really pushing myself very much." And that's not limited to math. ... Too many of our students, if you look at their attendance data, they don't put a very high value on their education.

Ms. Walters thinks that the American culture itself is partly and significantly at fault concerning why so many students are not mathematically competent (enough), or why they resist learning (more) mathematics.

I think our culture allows people to say "I'm really terrible at math" without having a negative stigma attached to that. Adults [say], "Oh I can't balance my checkbook. I'm really always been terrible at math." And people will think along with them like it's a funny nonskill to have. And I'm not sure where it begins or why we've allowed people to use that as an excuse but we have and that's very sad because people cough out at it by saying, "I'm not
good. Therefore, I don't have to be good and therefore, it doesn't matter," and they're really hurting themselves.

Some students at CHS tend to blame their mathematics teachers when they fail in mathematics. But Ms. Walters thinks that most of these students are either "unwilling to assume responsibility for their own education" or are "frustrated that they really do have some lack of skills that nobody has addressed and tried to help them."

So what does she suggest that schools do to counter the student attitude of getting by with minimal work? First, Ms. Walters says:

It's very frustrating. It's where there's burn-out because the teachers, I think, approach this job because they do truly desire to help kids. But when you give of yourself and give of yourself and give of yourself and attempt to pull the kids out and get nowhere, you know you still look for that spark. You still look for that, you know, that moment of success even if it's with a handful of kids.

Second, she thinks that a strong Board of Education is needed to implement stricter policies (e.g., attendance):

Until we get a board of education that is bold enough to make strict attendance rules and stay. The schools has a policy that if a student misses so many days, even if they pass the class academically, they don't get the credit in that class. They have to be in attendance. And they've been known to expel students because they cut school. They don't come to school, so they just say, "Okay, you're gonna be expelled. You don't get the option of even appealing. But the Board of Education [here] isn't bold enough to do that.

Ferdie: Why is that?

Ms. Walters: I think they would be afraid of being considered racially motivated in what they're saying. I don't know that for a fact but I suspect that ... it's some racial thing. But all they're doing is giving kids the right to walk the streets and not have anything happen to them.
I then asked Ms. Walters if there a need to look further into issues of race, culture, and gender? She does not think so. She believes that "kids are kids;" that there are some common things all individuals from differing sexual, race, and cultural backgrounds share and will, hence, be "beneficial to everybody."

At Copeland High, there is a special class for students who have failed the math proficiency test. It runs everyday and is being taught by a mathematics teacher. Students in this particular class are usually given worksheets to accomplish within a specified time. Some repeaters take it seriously and pass; some don't and either repeat or drop out. However, there is no special program for students who aspire to reach higher level courses but do not have the basic, prerequisite skills. Students usually "self track themselves when they come in to 9th grade," argues Ms. Walters. Further, "if, well a student has algebra in the 8th grade, obviously they're going to fall into the high track because they've already been predetermined to be better than average students." Students that come in the 9th grade at CHS choose either the college prep or the noncollege prep sequence. In the colleg prep sequence which, by definition, is the higher track, students take Algebra 1, Geometry, Algebra 2, and Precalculus. In the noncollege prep sequence, the lower track, students take Developmental Algebra A, Geometry and Algebra B, Math Modeling C, and (may) finish with Algebra 2.

We hope and we've been told that these series [i.e., noncollege prep] gives them just a basic, stronger foundation so that they can succeed at Algebra 2 and be prepared for College Algebra. But if there's seriously an engineering student or a math, science field that they're planning to go in, I think they're deluding themselves if they're not capable of Algebra 1 in the 9th grade and I
suppose that if they really want to improve, we can help them find a way to improve. But most of them don't go that extra distance to find a way to help themselves.

There is a considerable overlap in topics that are taken in Algebra 1 and 8th grade Algebra. So, if a student has taken 8th grade Algebra, he reviews basic algebra in Algebra 1 and proceeds to learn a more, advanced 9th grade Algebra.

When asked why similar treatment of lower track students is not available, Ms. Walters argues two points: First, "we don't have the staff."

(W)e're given teacher allocation based on the number of students and basically it's gonna allow one math class per student and one english class per student and so forth. So if they need to duplicate, we just don't have the staff.

Second, a more fundamental concern is that it "requires student interest" which many students at CHS have not a lot of.

For a particular student who has the interest, we can find the resources, computer-wise or individual tutoring or after school, if the student is willing to stay with a particular teacher who'd be willing to work with them.

Teacher allocation is based on student population. Also, students are provided with practically all the things they need to progress. Especially in the math and science areas, we have a lot of computers and we have those kinds of things. Whether the current teachers utilize them, I'm not aware of how busy the computer lab is for people to do that. I know there's a whole room with computers for students and teachers to use plus the library computers plus the writing lab computers. I mean there are technologically available things.

*The School Mathematics Curriculum.* The noncollege prep sequence of courses consists of: Developmental Algebra A, Geometry/Algebra B, and Mathematical Modeling C, with Algebra 2 as an optional fourth (final) course. The sequence is
designed to help a "weak" student to eventually cope with the rigorous requirements of the college prep Algebra 2 course (assuming that the student chooses to take it perhaps in his final year in high school). The noncollege prep sequence of courses is aimed at strengthening the arithmetic and basic middle school algebraic foundations which should have been acquired by any student in the "formative" years.

The college prep sequence of courses consists of: Algebra 1, Geometry, Algebra 2, and College Preparatory Mathematics, and Precalculus. It is expected that a student who pursues this track has the basic arithmetical and middle school algebraic foundations.

Each course in the sequence normally consists of seven units, broken down as follows:

1. Patterns, Relations, and Functions
2. Problem Solving Strategies
3. Number and Number Relationships
4. Geometry
5. Algebra
6. Measurement
7. Data Analysis and Discrete Mathematics

Each unit has a series of x-y objectives, and each objective is also assigned any of: process codes, level codes, criterion referenced test, and state learning outcomes. A process code is a targeted behavioral objective for a given topic. There are six process codes: Communication (Cm), Estimation (E), Reasoning (R), Connections (Cn), Problem Solving/Application (PS), and Procedure or Algorithm (S). A level code is based on the
District Model Curriculum and makes a distinction between three levels of thinking, namely: Knowledge/Skill (KS), Concept (C), and Problem Solving/Application (PA). A criterion referenced test indication (CRT) "denotes objectives which are tested on the end of the year Algebra 1 CRT." A state learning outcome (SLO) "denotes state learning outcomes for the 9th or 12th Grade Proficiency Tests."

A.1 The Teacher-Participants

If you leave the system now to our kids, they will ruin it. I've always been saying this: Education is a joke. The focus is on answers. I thought the aim of education is to encourage thinking, but the reality is the opposite. Take the proficiency test. It's like asking 2 + 2 and you simply answer 4, not focusing on the mechanics, the process of learning how to think. That's why I think education is a joke. Education really starts at college. These students who think they're weak prefer to value or side with their community rather than with the school.

Mr. Robison
Retired African American Teacher,
Math and Science Substitute Teacher
November 19, 1997

This ethnographic study revolves around four secondary mathematics teacher at CHS. Ms. Lynch and Ms. Prahst are Caucasian-Americans. Mr. Jack is African American and Mr. Taft is a Caucasian American. In this section, we learn about their lives and their thoughts about what it means to work in an urban setting. This chapter in particular is grounded in listening. One can view an interview politically as a performance of the self, but beyond that, it is enabling each participant a voice - the "hav(ing) of something to say" and "what people mean when they speak of the core of the self." I use Paul Ernest's model as an organizing tactic in "reporting data" on each

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3 Gilligan, 1993, p. xvi.
mathematics teacher's knowledge, beliefs, and attitudes about mathematics and mathematics teaching. Table A.0 below contains the components of Ernest's model.

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Table 5.0 Ernest's Model of a Mathematics Teacher's Knowledge, Beliefs, and Attitudes

4.1.1 MS. LYNCH
Ferdie: How do you describe math teaching here? Is there something
unique about teaching mathematics in an urban school?

Ms. Lynch: Well there's something unique about it. It's the group that
comes in and sits down. Well I try to calm myself down a lot.
And my patience has been pushed to the maximum amount
and I'm practicing more and more, focusing on: "Sit down,"
tell 'em what you want 'em to do, "Don't do anything,"
"Why are you out of your sit?" "Don't do this, don't do that." I
practice: "Sit down, get a book, find a pencil," and I feel
like I'm spending too much time doing that. But I don't see
an alternative.

Knowledge

Mathematical Background and Prior Meaningful Mathematical Experiences. In
her own high school years, Ms. Lynch had "(three years of) traditional math." What she
remembers about her mathematical experiences then was not really the force of content,
but the attitude her teachers expected of her and her classmates:

When the teachers told us where to open [our books], we did that quickly.
So they didn't need to be concerned with their methods and all these
things we've learned since then. ... We knew by the time we reached
high school what classroom behavior would entail.

When she went to college, she took a general math course which "wasn't interesting." It
"was boring. ... (T)here's nothing unusual at all." Then she dropped out of school.

Twelve years thereafter, she went back to school and got her degree in home economics
education. She recalls with fondness her instructor in trigonometry:

He was a lot of fun and I especially enjoyed the class because he didn't
make us memorize all the formulas because he'd put them on the board
and was mainly interested if we could use the formula with the
information given to find the answer, and I was good with that. And I
appreciated that. That was totally new to me.
Several years later, she decided she needed to study again. So she went back to school and this time obtained her certification in mathematics. She took two calculus courses, a course on the history of mathematics, and courses in abstract geometry and abstract algebra. She particularly "enjoyed calculus more than any math course" she has taken: "I enjoyed the teacher, and it was just a fascinating subject. He gave us a good introduction to calculus."

**Current Teaching Load and Level of Satisfaction.** At CHS where she has taught for five years⁴, Ms. Lynch teaches four Developmental Algebra A (for noncollege prep students) and two Algebra I (for college prep students) classes. So is she happy teaching these courses? She says:

I try to pick things that I'm especially interested. I don't get to cover a lot because (of) time. ... (B)ut the types of things I want to do I just run out of time and do not get to cover it. So some of the interesting problems don't necessarily get in there.

**Perceptions Related to the School Math Curriculum.** What does she think about the school math curriculum? Does it revolve around her students' interests and background? She says she's not sure because she thinks she's not "tuned in" to their interests.

Well I'm not really familiar with the background of most students. ... I try to pull in their interests. I guess I'm not very tuned in to what their interests are, and some of their interests that I'm aware of wouldn't be a subject that I would be comfortable to put on the board. (Laughs.) ... It's all in the age they are, it's almost totally social.

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⁴ Ms. Lynch has taught in the urban public schools for ten years.
Her being unsure about her response to the above question also stems from the fact that she is unable to think of "situations in math" that may be compatible with those interests. She says:

I can't think of situations in math, I guess. But I haven't thought of their interests that I can really incorporate into the problems in the classroom. Except perhaps shopping and sales tax and that type of thing. Except perhaps shopping and sales tax, and that type of thing. But they [students] don't worry about that too much 'coz when they ring it up the tax is already automatically calculated but ... and I don't think they think too much in advance what the tax should be and how much that would be added on to their bill.

Judging from student reactions, to some extent, she experiences difficulty negotiating her conceptions about the relevance of school mathematics in her students' daily lives.

Back to the school mathematics curriculum, Ms. Lynch claims she gets to cover approximately 80% of the intended mathematics curriculum, although she does not tackle topics linearly or follow the sequence as it is presented in the book. She likes to teach content on a "need-to-know" basis.

I don't know all the little details. ... I try to get things that kind of fit together. They fit together so you're just not teaching a whole bunch of little things that don't make sense to each other. So I don't necessarily try to do every little thing that they do. If they're [textbook authors and curriculum specialists] throwing in something in there that doesn't fit with the big picture, I don't put it in. One of the classes I had in translation, in one of the workshops, teach it on a need to know. In other words, if you're working a problem, and they need to know something, it makes more sense to the student if you present it to [them] when the need is there rather than you're teaching something that they'll practice and practice and they do not realize the need for that in their lives.
"Time is of the essence," she argues on several occasions. She explains three factors that make it difficult for her to cover the entire complement of material: First, the perennial problem of having more content to teach than time permits:

I think there's a lot to cover and I think it's difficult to cover even in a rigorous classroom. By rigorous classroom I'm talking about. I'm thinking back to when I taught in the private school. Students came in, we'd tell 'em to turn to a certain page. They all had pens and paper. Almost all. And you just got busy. You could cover material and review, and move on. Not everybody got it but a lot of people did. But that's not the situation I have now.

Second, the unnecessary "interruptions and distractions" perpetrated by her students:

There's a lot of time, literally eaten up with "I don't have a pencil" [and] people walking in late. People want to raise their hands and ask for a pass instead of asking a legitimate question. It just gobbles up time like a cancer. That's how it feels to me. So even the time I'm assigned, I don't have available. That's what I meant, I don't have time.

Third, the high rate of student absenteeism in Copeland High is a difficult reality she contends with daily:

I heard Mr. Jack mention this and this really is a serious problem. That a lot of students would come to us twice a week. They'll miss three days out of a week and that's not unusual. And they feel like they should still be able to get it. And that you should be able to explain in two days, explain what you're really gonna explain in two days in such a way that they can understand it. I mean, they put a lot of responsibility on the teacher while they are off. Some are here Monday and Tuesday and by Friday, you should have explained it well enough that they can understand it. If they don't, it's your fault. You don't explain it very well.

The Stability of Mathematical Content. I asked Ms. Lynch whether the content of school mathematics has changed over the years. Ms. Lynch said she does not think so.
However, what makes more sense is that the emphasis changes, or the way she presents the materials varies from year to year, or the focus can be different. But overall, the content, she believes, has not changed at all.

*Teaching Math in an Urban Setting.* Ms. Lynch thinks that teaching mathematics in Copeland High is very much constrained by the realities of her students' lives, their situation being in an urban setting. She states:

> If you mean they come to school tired and hungry without very much sleep the night before, maybe. Whatever they might have been doing the night before might be on their mind and they haven't cleared that all out to really focus on what we're doing in the classroom. Yes, I think it interferes. Sometimes if I ask a student to do the worksheet and practice to see whether he understands or still has a problem, he'd say, "I can't think about that right now. I just don't know how that work." They don't want to pay attention 'coz they don't feel this [i.e., math and learning math] is important compared with what they're trying to deal with.

*Significance of Students' Socioeconomic Status.* Ms. Lynch is unsure whether her teaching *may differ* somewhat if her students belonged to a higher socioeconomic status:

> I'm not sure, I may be right. Well we probably would be able to cover more material. We would be able to do more difficult things because I would have more attention. I can cover more ground, in that respect. But most things about my teaching wouldn't change. Well, it's hard to say.

Overall, are her students prepared to tackle college-level mathematics? She claims no.

> They think they are. And they're actually angry with me. This is a college prep course. I give 'em an assignment, I expect them to do it [with] pencil and paper, [and have their] notebooks, take some notes. They don't take notes unless you specifically say, "This should go in your notes." When they don't remember, well [they would respond] "You didn't tell us to put that in our notes." They're not responsible.

**Beliefs**
Conception of the Nature of Mathematics. Mathematics for Ms. Lynch is "more than computation:"

It's problem solving and using a situation or using mathematical ideas to solve a problem and get through a situation that involves an expression or an equation.

Her statement below seems to suggest that Ms. Lynch's notion of problem solving mainly involves the application of formulas that are drawn from geometry (such as area, volume, and so on) and consumer math.

I'm more comfortable with areas of triangles, formulas that get into where it might be useful at some point, to find the area of a room or the perimeter of a field or problems involving shopping, sale price, going out to dinner, going out somewhere where adult tickets might be one price and kids' tickets are another price.

Model of Teaching and Learning Mathematics. For Ms. Lynch, "learning is an active thing." Students, according to her, are as much responsible in the learning as their teachers are. But her students do not seem to respect the mutual task/obligation. She states:

(S)tudents think of teaching, the ones that are really verbal, I should be able to say something clever that would make them understand it just like that. They don't really see their role in the whole process. They don't see learning as an active thing. They see it as passive. They believe that if they sit here and I do my job right, they're just gonna get it. [Students] need to take part, there's a responsibility there. I'm merely here as a guide. A guide -- not someone that can say the magic words and you'll just suddenly understand.

The Reality of Teaching Mathematics: Dealing With Students' Negative Attitude

Towards the Subject. Ms. Lynch believes that teaching mathematics involves finding ways to deal with students' negative attitude towards mathematics.

(A) large number of students are really turned off by math, and were
convinced that somewhere along the way that math is for weirdos and smart people only, and that they don't understand it and they'll never understand it. They won't try. It's a handicap in that respect. They tune out to some extent -- "Oh I don't understand that," "Oh, it's too hard for me and I just can't get it." Don't even waste your time.

*The Reality of Teaching Mathematics in an Urban Setting: Dealing With Student Absentees.* Ms. Prahst believes that teaching mathematics in CHS involves having to deal with the high rate of student absenteeism which may be both a cause and an effect of why so many students fail math:

(S)tudents don't give themselves a chance to pass ... because they absent so much. They don't seem to understand that when they're not here, we still have classes and we still move on. And so if they miss three or four days, then they don't understand that they're still responsible for learning what we give while they were absent. They need to be told. So when they take a test, they say, "Well of course I didn't do well because I wasn't here." They just don't feel responsible.

Even with students that are usually in class daily, Ms. Lynch finds it difficult to convince them to learn math:

Some of the students will come to school but don't feel well and have a variety of reasons why. They feel tired and don't feel like doing the work. They don't do the work even when they're here in school.

*Perceptions About What Constitutes an Ideal Mathematics Student, an Ideal Math Class, and a Mathematically Able Student.* For Ms. Lynch, an ideal math class would have responsible students that are eager to do the work assigned to them and are excited about sharing what they know to other members in class.

An ideal math class would be that the students would come in excited to do what they were gonna do or what was planned for the day. That there would
be an introduction for what we’re gonna do today. An introduction, a start that they would come in and actually write down and give it a little thought.

Significance of Group Work. Ms. Lynch believes that group work, if done successfully, stands to encourage students to talk about what they know. Also based on my observations, I can say that group work is a major activity in her classrooms, inspite of the noise and the distraction that occur almost always in her classes. In fact, part of her notion of an ideal math class has students engaged in group activities. She says:

[There] maybe a group activity where the students would discuss and share ideas. [It would be an] activity when they work with two or three people and when you walk by, you would hear discussion about that and not who did what to whom over the weekend. The discussion would be what we’re doing. Ideally, they would actually be excited about what they’re doing in class and stay focused on that problem. When they come back, we will discuss it as a group, that they would be anxious to share with the group what they found out. And then when you ask them to write about that, "What did you learn? "What were you surprised about?" they would be even anxious to tell me.

Ms. Lynch believes she has never had that ideal math class. "I mean it comes close on some occasions, but not everyday."

Experiences with Tracking. I asked Ms. Lynch whether grouping students by achievement would enable her to cultivate ideal math classes and students? Ms. Lynch insists that instruction would still not be beneficial - especially those in the remedial sections - if done that way, at least based on her experience at the present time.

Because they [administrators] have pregrouped kids into Algebra A, so all of the students are in there because they lack interest in math or ability in math. So they're already at that negative mind set when they come in.

Tracking makes it hard for any group activity to work, argues Ms. Lynch.

(Y)ou're trying to put them in group activities, and you don't have anyone
there with the strength to lead the group. They tend more to bring each other down instead of helping each other out. ... They're all struggling, so who's gonna put the insight?

*Principle of Education.* So whether or not students are grouped, or whether or not she gets to have ideal math students in class, her "number one goal" for all her students is that for them to "have some kind of successful experience in class. You know, have a little bit of glimmer of understanding somewhere."

*Other Concerns: The Illusion of Autonomy.* Ms. Lynch believes that she does not have much autonomy in making decisions about curriculum and course content. She identifies three causes: she feels the pressure from her administrators to cover requirements, time as a problematic factor, and a "bad" experience she has had when she wanted to make innovations.

We have certain things that we're supposed to teach and that if we vary off of that, then we're not covering their [i.e., administrators' expectations]. There's really not time, too. Another experience, too. I remember I had some ideas I really wanted to try. The first year I was here, I liked to work on the computers. We did drills and practice for the proficiency, but Mr. James[^]{Pseudonym for a former mathematics department chair at Copeland High.} said, "Oh that's not on the curriculum. And you don't have time to do that."

... You better stick with what you're supposed to do."

*Teaching Mathematics as an Ongoing Process.* Ms. Lynch believes that mathematics teaching changes for her each year since that is a way to "survive. It changes all the time. I want it to work better." The change is not linear, she insists. "I try to keep things that work. It's not a real steady line in any direction. It certainly is not going this way or that way. I just pick up and choose from things."

[^]: Pseudonym for a former mathematics department chair at Copeland High.
Perceptions About Reform and the Standards. Ms. Lynch is aware of recent reform in school mathematics. Regarding the Standards, she thinks the model is interesting in the sense that students now are being asked to view mathematics in different ways.

When they talked about that years ago, it was something they wanted to give the students as early as third, fourth grades. To think about math in a lot of different terms than we ever did in school so that by the time they go to junior high, they had some kind of basic understanding of numbers and how they work.

Ms. Lynch believes that problem solving plays a significant role in the way the Standards is framed.

I think the Standards work toward that by ... you have a problem rather than say well which formula, which little computations are used for that to actually think of how numbers work and think through a problem. I thought that was the goal of the Standards. It's problem solving that had the great promise.

But, while she applauds the reform effort, she claims she doesn't "know if that's happening:"

I don't think so, based on what I see when they [students] make it to the ninth grade. ... They don't come to me with that information.

Perception About a Multiculturally-Based Mathematics Teaching and Learning.

Although she does not think it ought to be a major concern, Ms. Lynch believes that the reform concern for a more multiculturally-based mathematics teaching and learning is interesting. She argues as follows:

[I] bring in topics that would be of interest to all cultures and not single one out. But I don't put too much emphasis on that. I just try to pick things that would be interesting. I enjoyed my history of mathematics so much ... if I
can pull in all cultures and see who contributed what to the field of mathematics from all different cultures. I find that interesting and I think some students might.

**Attitudes**

Ms. Lynch thinks that school mathematics is not always changing, but it does not mean it's cut and dry.

[School mathematics] is not always changing. I mean a lot of it, unless we're talking of curved geometry, it's not changing between, but I still don't see it as cut and dry. I mean there's a lot of things that you can introduce that are interesting enough. You don't have to be dry. It may be cut, but not dry. ... I mean you can get an interesting subject to present materials that aren't changing. There's a lot of things you can pull and put into unchanging things.

**Ferdie:** *If there is one thing that you want the school to know, what is it?*

**Ms. Lynch:** What do I want the school to know as a teacher, about what goes on in the classroom? Well I guess I would want 'em to know how difficult it is, the interruptions and distractions you have with students that aren't in here for any purpose whatsoever. And I'm not talking about a student that returns a book and shoves his feet on the way back to his class. That's nothing. ... And I don't think they [administrators] realize it, they might, if they have a video camera in the classroom. That when they walk in the classroom, typically students sometimes they seem 'em coming down the hall. Now by the time they walk in the door, everybody's sitting down doing what they're supposed to be doing. If the administrator's there, you know, they tend to show their best side. I don't think they even have a clue as to how disrespectful the students are, and they're [i.e., students] good at it.

**A.1.2 MS. PRAHST**

**Ferdie:** *From the survey, you responded "not sure" to the item, "The goals and priorities of my department are clear." Can you expound more on that?*

**Ms. Prahst:** I don't know that as a department, we have any kind of idea

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what our goal is. I think we're all just these little satelites out here doing our own thing. .... It's just because I don't feel like we as a group have goals. I think we're just out here getting by and we don't have much contact with each other.

**Ferdie: Why is that?**

**Ms. Prahst:** We're not forced to. The staff in the math department is not talkers. I'll talk forever but I won't talk at people. You try to, whatever you want is fine. And that's the kind of attitude that you get. .... (T)his particular group of people is just "I'm gonna do my job. Let me do it." And that's okay, but we don't share with one another what's going on. And we all have opinions of each other, some higher than others and we don't expect. .... I just work. We're a good group of teachers, but we're not just cohesive at all. We're all just kinda all do what we have to do.

**Knowledge**

*Mathematical Background and Prior Meaningful Mathematical Experiences.* In high school, Ms. Prahst "took the normal college prep related courses - Algebra 1, Geometry, Algebra 2 and precalculus. ... I was ready for calculus when I went to college."

In college, she pursued a degree in physical education. She took three calculus courses and courses in linear algebra and statistics which enabled her to have a minor in mathematics. When she graduated in college, "there were no jobs in physical education and that was okay 'coz I really think that I'm happier in the math classroom 'coz it's more structured."

Ms. Prahst has always had positive mathematical experiences. She recalls her experiences with her "very good" college teachers:

My calculus 1 and 2 teacher, he was excellent, and I think that's what taught me to keep going on. He was a former high school teacher and he taught as I would say like a high school teacher where he really explained it out. Calculus 3 was interesting 'coz this guy was a theorist. (laughs.) So that
was a challenge. And then I had linear algebra and statistics from a really, really good professor, I'd say what I would consider a college teacher, not really a theorist.

_School Mathematical Knowledge is Broadening._ Ms. Prahst thinks that the domain of school mathematical knowledge she teaches is "broadening:"

I think working with Mrs. Stevenson has helped in that way. Because it used to be that skills that you were worried about. And now its the use of it as well.

She thinks that "physics is mathematics driven" and that algebra is useful in chemistry and in the other sciences: 

"(M)y students last week [were] saying to be at least be good at solving equations ... because the idea that what I can't compare, I have to add from here, [and] if I add it to here, I add it to there."

_Current Teaching Load and Level of Satisfaction._ At Copeland High where she has taught for fourteen years, she teaches three Mathematical Modeling (for noncollege prep students) and three Geometry classes. She expounds on the nature of these courses in the following way:

This year I only have college prep geometry. ... I have math modeling which is an intermediate algebra. It's to further prepare [students] for Algebra 2 through going over a lot of Algebra 1 topics. But you know we spend two thirds of the year doing linear type things, and then the third of the year doing parabolas. So the linear is Algebra 1, parabolas are Algebra 2 with square roots and complex numbers added in as well.

Then I asked her if she is happy teaching those courses? Her response is in the affirmative.

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6 Pseudonym for a physics teacher she regularly collaborates with at Copeland High.

7 She's talking about the operational rules in obtaining equivalent equations.
Geometry is my number one because I'm not, I always thought, I'm not cleaning anybody's mistakes, can start with fresh new topics, mostly. Ahm and that's why sometimes I stay away from the algebra aspect for geometry because why do we struggle with this little algebra thing that they didn't get when we could be doing all this stuff with geometry. Although, they need to get some algebra refresher, and I'm trying to do more this year.

_Perceptions Related to the School Mathematics Curriculum._ Regarding the school geometry curriculum, she normally covers 11 of the 14 chapters recommended for Columbus Public schools. She believes that her main job is to teach her students the basic foundations of geometry

I don't get into the solid geometry at all but I feel very good about, you know, they get their basic foundations, their congruent triangles, their similar triangles. I try to stress the right triangle in trigonometry real well, and circles and as much area and perimeter as we can get into.

Ms. Prahst does not usually get to cover the intended fourteen chapters because of "time frames." She explains this in the following way:

That's usually about where May hits, and unfortunately, it's time frames, it's not students, for example. Like this week, we cover very little because it's close to Thanksgiving. For the next three weeks we won't get a whole lot covered 'coz we're so close to Christmas and it's .. and the kids are missing because of this and the other one in May, you figure out three and a half days a week you get to teach just because kids are in and out and you're really hitting on everything.

In a later interview, she adds that some chapters are "over the kids' heads" and thus, she does not see the need to teach everyone every thing.

Some of them [i.e., chapters] works over the kids' heads. So why wait? Why do it to the mass? Let them do it out when they get to precalculus. There's less of them and those are the ones that can handle this. I mean that's one attitude you can take. But I think that the realistic expectations (is) to do the best you can to progress the students on, and it's unfortunate that we can't reach the goals. ..(T)hat's why we have such an imbalance of .. what comes out of the courses.

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I asked her if the school mathematics curriculum revolves around her students' interests and background and she responded, "probably not necessarily." She insists that "school mathematics revolves around what they need to get to college" and since mathematics teachers know what is and what is not important, or what prerequisite mathematical knowledges are valued, then she thinks that the school mathematics curriculum "revolves around what we [teachers] think they should know and it's up to [us] to bring it into .. make it relevant to their own lives." However, she cautions, "we probably don't do a good enough job of that."

*Perceptions About a Multiculturally-Based Mathematics Teaching and Learning.*

I asked Ms. Prahst if she is at all concerned with the triadic issue of gender, race, and culture in the teaching of mathematics. She says "yes" but insists that those issues are not major concerns. She thinks that some of her students "just don't care" and "just wanna learn stuff."

You know when you try to use a national textbook that's trying to hit every culture and area of the country, you know, some of it appear irrelevant to the students. You try to bring some in but even so, you're not sure what their backgrounds are. For example, when you do probability, you talk about cards, [and] some kids have never used a deck of cards for religious reasons and you go on with what you think is common sense and it's not common. For the average student and your interested students, they don't really care. They just wanna learn stuff.

Ms. Prahst also claims that in the fourteen years that she has been with CHS, she has never seen race and gender inconsistencies in her classrooms.

I've never seen it [race and gender inconsistencies, that is]. Ahm I don't know
if that's because I personally as a female never had any trouble with mathematics. I've never seen the fact that a black student does better or worse than a white student as the stereotype.

She thinks that learning is mostly about having "self motivation and personal interest."

I have a couple of Hispanic students for the first time this year. And they happen to be brother and sister and they're both excellent math students. And some of the(m) [will] gonna shine out, but I've never noticed any difference between whether it's male or female, or what races they come from. Ahm whether or not girls are less likely to answer, I don't think that's necessarily true. ... I've never really studied myself but I personally think that a lot of that is an excuse and people would use it for an excuse. I've not seen that. ... I don't find it, unless I'm naive.

*Teaching Math in an Urban Setting: Problems with Students Who Do Not Do the Work.* Ms. Prahst claims that mathematics teaching in CHS is constrained by the fact that students seldom turn in assignments:

It's constrained within I think whether or not students would do their homework and their motivation. ... (W)hat I find [about] most of my ninth grade geometry class [is that] if you give an assignment you can guarantee that 90% of it would be turned back. My 10th, 11th grade geometry classes, I hope I get 9 turned in.

Because students do not do their homework, a necessary exercise in acquiring mathematical skills and concepts, that already forces her to always repeat her lessons for everyone's sake, which for her is really a waste of time.

I mean it's frustrating and you find yourself not wanting to repeat but just for the sake that they didn't do it, I better. Because the students ... d(on't) know

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8 I took this as an observation task. My classroom observations after that first interview became somewhat focused on the interactions between her and her students. Although I was unable to monitor the kinds of questions her students asked - girls and minorities especially - I made tally sheets and counted the number of times she interacted with her female students and African American students, and compared that with the number of times she interacted with her Caucasian students. I did not notice wide, glaring differences. In fact, in some of her classes, the students were mostly African American males and females.
how to do or know what a linear equation (i)s, well, you try to think he wasn't here last week. Well he was here everyday last week. They just don't tune in and you have them for their 40 minutes and then they're gone. They don't come back and think about it for another 24 hours and hopefully they'll then think about it. So, the carry over from day to day is what I find most challenging.

Ms. Prahst thinks that students have difficulty turning in their homework because of the way they approach the subject: they often "leave the class and don't think to do it again. They can have a worksheet half finished when they left the class and they don't come back half finished. They don't think about it." Ms. Prahst hypothesizes that one source of students' lack of desire may be well rooted in the family and the society, in general.

I don't know if their homes aren't structured to check out the homework. Although you know when you speak to some parents, you know that they are structured to do so. ... (T)hey're lacking some responsibility, I suppose. They put other things first and school last, and they're allowed to do that by society. And it comes down to family values, too. I think families have to structure around the society, they know that school should come first up until they graduate.

I asked Ms. Prahst the kinds of questions she usually give as students' homework. She says the problems assigned do not usually require students to think anew.

(C)oz when I ask them to think anew, [they would say] "I can't do it." So I try to pick homework assignments where I felt like I've gone over it and they can do it. So if I've chosen a book assignment for them to do, it's because I know that I've gone over it, and explained it, and that they can go ahead and do it. Because if they can't, they won't, even if that means flip pages back and find out how to do it.

Beliefs
Conception of the Nature of Mathematics. Mathematics, for Ms. Prahst, consists of two levels:

(B)eing able to function with the arithmetic, first of all. But then also being able to answer some of the thought questions. ... (M)ore and more math is becoming the thought process behind it rather than just the skill base.

Ms. Prahst strongly believes that the "younger age" should "get the skill-based" content of school mathematics:

I've always believed by the time they [students] get to high school, unless you're working with them one on one, you're not gonna keep studying the basic skills. You can teach them algebra skills and so on, but not the basics. They have to be one on one by that time.

Model of Teaching and Learning Mathematics. Ms. Prahst admits that probably there are similarities between the way she was taught mathematics and the way she teaches mathematics, "similarities in the explaining part." The difference she sees has more to deal with the amount of problems she assigns to her class and the role of questioning and dialogue in her classroom/lecture discussions.

The differences would be I don't think I require much practice as like in high school, we did. Like the algebra class, you would take ... you would do 25 problems in class and 25 for homework, ... so you should do the whole set of 50. Although I think we were probably lectured to more directly by the teacher, I think I do more of questioning. Try to get the students to answer and go along with that. So I think I vary 'coz I like them to speak and tell me what they know, sometimes to a fault. Sometimes they need to be dictated to, and that's true for some others more than others.

To teach mathematics (effectively) for Ms. Prahst means to do any of the following:

Clue in to your students. Meet them where they are, don't ever put them down. Assume they know nothing. Ahm but as you're teaching it, don't be downgrading to them. Pretend like you're just reviewing it rather than teaching it for the first time. It means a lot ... some of it is playing games with them. Like when I taught general math, I never used the word *algebra*
even when we were doing algebra because that freaks them out. You have to play little mind games with them. ... Just be honest with them. Try to come down to their level and if what you did didn't do go well, then don't blame yourself and regroup, come back tomorrow and if you can.

To teach mathematics also means to personalize, and supplement and/or contextualize the textbooks that students are using, as well as to let them know that because she works hard, she expects the same from them.

I think I find supplementing the work that they're doing helps very well rather than using the book. ... (I)f you use book tests, try to customize them for yourself. Personalize it. And I think let the students know how much work you're doing, and I think then they have a little bit of respect for you. They do take you for granted. But you know you worked hard, too, and let them know that you expect them to work hard.

*Continuity as A Unique Factor in the Teaching of Mathematics.* I asked Ms. Prahst if there is anything peculiar about teaching school mathematics, that is, unique to the discipline? "I think the continuity of it is unique," Ms. Prahst says. She makes a distinction between the teaching and learning of history from that of mathematics, as follows:

You know when you think about a history course, if they're doing, say, the revolutionary, if they did that in 2nd grade or 7th grade or 10th grade or 11th grade or whatever, all they're doing is delving into details. They're not really relying on past knowledge.

It is interesting how her perspective of learning in mathematics is related to students' "emotional" baggage that is "always-already-there:"

Math students come in with a lot of baggage, both good and bad, you know. If they didn't learn fractions back in the 4th grade, now they got fractions phobia, and they'll just see a fraction, they freeze up and just say that "I can't do that." Well I think you'd run into that in other classes because you're constantly tackling new but repeated materials, they look more differently.
Learning mathematics, Ms. Prahst further argues, involves a sufficient knowledge of prior concepts and skills.

(In math, they're really relying on a lot of previous skills. They just crop out of nowhere you know. Negative numbers here, fractions there, adding this, subtracting that. Thinking learning definitions takes a full realm of that and I think probably just like in the other subjects, you either like them or you don't like them. Where in math you can get real "I-can't-do-it" kind of thing 'coz you're always asked to do something rather than just listen or read or whatever.

*Integrating Science and Technology in the School Mathematics Curriculum.* At CHS, she collaborates on a regular frequency with physics teacher Mrs. Stevenson and is an active proponent of "technomathematics" for students. Ms. Prahst does not see technology as capable of changing the nature of school mathematics. She sees technology as *merely* but a powerful tool that is capable of aiding especially those students who lack the basic (arithmetic and algebraic) skills learn the concepts better: "If I can get this concept across without worrying about the skills, then I feel like students can grow." She says:

In the math modeling, I like it because they [students] can .. when you're doing intercepts both and also with parabolas, how they change, how you figure it out. It's just more powerful to do it. And so many of the kids ... because that's the lower ability group only because they don't have the background. Graphing on paper is something they don't do well and they do very slowly. And by using technology, they can, you know, once they learn how to type it in, they can change it very rapidly and they're not held back.

Through technology, Ms. Prahst argues, a student at any level "is not held back. ...

Technology is necessary to move on."

That's what I like about any kind [of technology], even just the basic work
on the four function calculator like we used to when we had general math years ago. I was not holding any student back because they couldn't multiply or they couldn't divide. We could learn proportions, we can do scaling, and we can do things if we use the calculator. I think technology is necessary to use to move on.

Ms. Prahst is, of course, very much aware of the disadvantages, especially the common story about students being incapable of manipulating mathematical symbols in the absence of calculators. Unfazed, she remains optimistic:

(Student) can become too reliant on the calculator, and I have found that to be the flip side of that. You know I want them to learn how to solve equations but I don't want them to get hung up on their inability to do negative numbers. Therefore they also need to have a practice of negative numbers. So it used to be that you're killing two birds with one stone. And now you're not doing that. Now, you're just focusing on the equation. So let's use the calculator if you need help on the numbers. So it has its plus and minuses. And I think we have to find some kind of balance ... which will satisfy both.

Perceptions About Reform and the Standards. Ms. Prahst is "somewhat" aware of current restructuring in school mathematics, such as the Standards and the constructivist reforms. Regarding the Standards, she says:

When the Standards first came out, I was really concerned that they would gonna phase out the geometry course altogether. And since that's my first love, so to speak, that worried me because they really talked about integrating a whole lot more. But I don't get that feeling it's not gonna happen. I think that there must still be a need for the geometry course.

The Standards can be interpreted in many different ways, and Ms. Prahst is concerned about how state department officials interpret the document devoid of the urban context:

(They) honestly believe that all children will achieve at the same level at the same time, and so that therefore there should be one algebra course, one geometry course. (The) cause behind that is that until you start repeating students for failing that's not gonna work because you have 9th
graders with perfect attendance, 9th graders with 50 days absence, 9th graders who don't care. So you are really penalizing your best students if you're gonna do that. You do need to keep them separate.

*Discovery learning* for Ms. Prahst "is a form of constructivism" but employing that requires time. "I believe that you can't wait forever for them to discover and therefore, you have to move on." Instead, a method she finds effective, in place of small group cooperative learning, is "lead discovery."

You can't wait for some kids to learn. So eventually I think you do have to tell 'em and make sure that everybody has come back with the same results. Ahm so it is valuable but I still think they have to be led.

In a later interview, Ms. Prahst remains unsure about giving students full opportunity to explore mathematics on their own. She argues as follows:

So many of them is just, "I'm gonna do this 'coz I have to do it." (T)hey should be given more opportunity to explore 'coz that would force them to do some things. But they also lack a lot of the necessary skills before they start. Even if you tell 'em to try to come up with a pattern for, [say,] how many diagonals there can be total in a polygon, it's like, "Huh?" Or the ones where you say, "Draw from one vertex," they draw from every, you know, there's no connection there, and I don't know if it's lack of focus or what.

Why is it that students cannot seem to make that transition from group or teacher-directed instruction to individual discovery? Although not too sure about why, Ms. Prahst identifies four interconnecting possibilities: they either "give up too easily," or "even if some students that ... are excellent students, they've not had the training to ... go up by themselves," or "they rely on one another too much." The fourth reason deals
with students' apparent lack of self-confidence and self trust about their answers. This is based on the following experience she has had with her geometry classes:

(T)he other day, we showed them how to do a scaling thing, and then each have to take a different state of the United States map. They didn't like that 'coz they had no answers to compare to. They just had the process and that group, in particular, has so relied on comparing answers with each other that they don't trust themselves to have the right answers. My math modeling class liked it the other day this week when I wrote the answers on the board. ... They gotta get it right, and that's what they really like, and they're afraid to take a chance.

**Perception About Group Work.** Ms. Prahst insists that she has not done enough group work to fully convince herself of its effectiveness as a classroom learning strategy. Aside from that, her being a "control freak" prevents her from leaving students to work by themselves.

[I don't do group work] probably because I'm a control freak. (Laughs.) I like to be involved. I do get bored when I give them something to do and I don't have anything to do. I get bored but I haven't found or have really tried to find a way to organize them so that they would do the work. I find that it has not been effective.

**Perceptions About What Constitutes an Ideal Math Student, an Ideal Math Class, and a Mathematically Able Student.** For Ms. Prahst, an ideal math student comes to class as an active participant and focused, and does not easily give up.

You can think of them as the normal who bring stuff to class and pay attention. But really it's just to be focused, to know from one day to the next what happened the day before. To be able to retain, to know that yes, you're gonna miss something every once in a while, but to be reliable in order to do it. When something gets tough, not to complain about it. That they're interested in learning, and they wanna participate and if something's not right, they ask questions. They don't just sit back, they don't want to complain, "I don't get this stuff." And you don't mind if you bring more work unto them.
Further, the ideal math student is "willing to do the job ... no matter what."

I just wish that they would just be willing to do work, just do whatever comes along. The ideal student, no matter if you're good at math, or good in English, you just do the work, no matter what. ... Students I had last year said I had to learn about doing things ... and (students) said "you know, would you do it?" And I said if I wanted to get an A in the class, sure I would, 'coz I would do whatever the teacher said I had to do to get an A because getting an A was important. ... I wish students would be more willing to do whatever it was to succeed. I’m not saying you have to get all As, but, you know, but doing whatever possible.

Some mathematics teachers believe that the number of ideal students and/or math classes are decreasing, and that "students are becoming more and more dumb." Ms. Prahst does not believe so.

I wouldn't say that. I think it still comes back to motivation. I still think they could do it if they would do it. ... (W)hen I say that I don't get to the depth of what I used to get to, it's because you beat yourself against the wall for so long that you just go ahead and move on, you know.

_Changing Focus of School Math Content._ Ms. Prahst insists that mathematics teachers ought to get used to the fact that the focus on mathematics content changes year to year, from one reform to another, and from one book to the next.

For example, with the idea of proof, I try to introduce with ... the parallel lines and they just don't get it. So it doesn't end up on the test. It's the way the textbooks, that particular ideas which textbooks are structured. They don't require as many proofs as they used to, which is fine. But the students, they're not forced to tackle some things.

_Factors Affecting Student Performance in the Math Classrooms._ Of course students are not totally excused themselves, Mrs. Prahst adds. But mathematics teachers need to realize, too, that "family factor" contributes to the "crisis" and, for all of us that live in the now, "life in general is so absorbing."
I don’t think the students are getting any less competent. Ahm, I think that their motivation, their laziness, and and just life in general is so absorbing. There’s so many things that take your energy away that you go home exhausted in the evening and you just you can’t get the homework done. (I)t’s going to get worse because of everything .. in the family structure and everything else. So they’re definitely not less competent. From what I see my own children doing in elementary and in middle school, they’re being exposed to it, required to do it. All they gotta do is do it. I mean that’s what really it comes down to: they just need to start doing it, and they’re not doing it.

**Issue of Accountability.** Ms. Prahst thinks that "accountability" has been, rather, taken for granted by the mathematics community of teachers (both elementary and high school):

(T)he high schools blame the middle schools, and that it’s true because they can be passed on, never pass a single math class in middle school but they’re promoted anyway. And then from high school, we deal with those kids that passed all the courses. ... (W)e should have some more accountability. I don’t know if testing, the way testing is, you would know or not. Proficiency testing, I think, is good. But I think it could be more.

Ms. Prahst suggests that perhaps a nongraded system may work, or that teachers find ways to go beyond stereotype expectations in each level, or simply "letting children achieve what they can do."

Maybe we need to somehow go to some kind of nongraded and I don’t know if that’s gonna work either ‘coz we still have the stereotype of if you’re in the third grade, you should have this. But we ought to start just by letting children achieve what they can do.

**Teaching Math in an Urban Setting: Dealing With Student Resistance to Knowledge.** Ms. Prahst believes that mathematics teaching has changed over the years. Actually, it has intensified. "I try to do more ... to give a real hands on thing," she says. Although she is still in the process of negotiating with herself the merits of doing
"constructivist-based" type of learning because from her experience, it seems that students are not usually able to make the transition from discovery to doing textbook problems on their own. And because many of them do not have the initiative, most often they need her to give them some direction.

I'm still not sure what the students get out of it is intended to get out of there. For example, do you spend the whole period doing a discovery activity, could they then go to the book and do the problems? I don't see they cannot make that transition on their own. But if you sit up here and they practice ten problems on the board, they probably can do those problems on the board. That the teaching aspect of it, the students I find I think need a little bit more direction, they don't have the initiative or they just have the reliability. Maybe we constantly have to do that, or the teachers to make sure they explain it. ... So the teaching aspect, I just find myself .. trying to make ways for students to see it happening.

Ms. Prahst goes back again to the reality of student resistance to doing work in the classrooms. Teaching mathematics in the present has less to deal with the teaching of skills and content, in general, but more to deal with ways she can convince her students to learn skills and concepts.

(They're not of an accepting nature. ... I mean, that's the way math was, I mean here's the problem, this is the way you do it and go do it. [Students] always ask, "Why are we doing this stuff?" and that's not unusual. But just that, there seems to be more it seems of a fight to try to get them to do stuff. And so I'm constantly trying to think of ways to to fake 'em into doing something. I sometimes feel like I'm doing that. It's faking it, you know. How can I present it, it's like a game. How can I present this to make them do this ... ? That's how I find math teaching has changed. I don't think my focus on skills has necessarily changed because I don't find that there are that many basic skills to teach.

Indeed, having stayed in the math classrooms for ten weeks, I noticed how so many students are openly resisting to learn mathematics. Ms. Prahst claims that students
now are less concerned about their learning. This attitude, Ms. Prahst adds, "maybe a reflection of society."

I don't think they wanna do the work. ... I think there's a lazy side to 'em. If it doesn't come easy, "I don't wanna do it" and they don't see that if you practice the steps, ... it'll make it easier in the long run. It's like it's a "give-up-too-easy" kind of thing, and I don't have an explanation for why that is. "But if it's hard, I'm not gonna do it." And I don't know if that's a reflection of society -- "Well, let's take the easy way out if it's too hard for you, then we have to do something else." But I find more students are accepting bad grades now than they used to be. 55 was a low score which you know would be close to a passing D. Now you'll still have a few of those 55s, but there are some kids that hang out in the 30s, and don't do anything about it and that used to be terrible. But they're accepting of low scores, and I don't know why.

Perhaps student resistance to mathematics is an indication of the incompatibility between the school mathematics curriculum currently being offered and the kind of mathematics that students may find relevant, useful, and purposefully situated in their own lives? "I don't think so," she argues. "I don't see why they are not capable of doing whatever math is taught to them." Ms. Prahst insists that the department is up to date insofar as books and NCTM recommendations matter.

I mean we've gone out and we've gotten the latest books, the ones recommended by NCTM or recommending NCTM standards, and that's the thing that we looked on in this last book adoption, you know.

But she feels some teachers in her department are resisting the change. "We are trying different books, and some teachers are fighting it. They wanna use the old books the traditional ways," Ms. Prahst argues.

In her own way, Ms. Prahst now tries to make mathematics interesting to her students that resist mathematics in the following ways:
Geometry-wise, I try to do hands on, that kind of thing to make it more interesting. I try to bring in some artistical kind of things. .... I try and right now, my best effort is to try to give a variety, not to dwell on a topic too long. ... Even though you're gonna use that item or that idea, just go ahead and move on, and let's try something else, then we can come back to it.

Changing Textbooks. Ms. Prahst is disheartened with the new textbooks because they "don't have enough practice set."

(1)t used to be two pages of problems. Now, it's two thirds of a page of problems and the other one and a third is going to be word problems .. put in social studies ..(T)hat's good to put it in context, but you don't go away with the conceptual foundation.

Ms. Prahst's Version of Tracking: A Regrouping of Instruction. Ms. Prahst claims that she "understand(s) why tracking does not work." But she feels there is really a need for a "regrouping of instruction" in the math classrooms because there's usually more "run-in-the-mill" students than there are really good ones.

(1)hat there's some criteria set for which classes you take and which groups of students go with them. ... (W)ith the type of students (I) feel (I'm) dealing with, if you have 25% excellent students and 75% of the general run-in-the-mill students, those 25 will come to the 75, rather than them challenging the 75% of them. Where if you have 75% good kids and 25% low, that would be enough to pull them over. You need a majority of good to pull them off. You don't put one good kid in a group of four. You put two and two. You put two good kids with two other kids because if you put just one, then they'll let the one do all the work. And the one's not gonna complain either. But if you put two or three of the good ones together, then they can talk and challenge themselves. ... (1)if you put half the kids that go around and aren't serious students, the other students will suffer.

Ms. Prahst sees the need for her version of tracking because mathematics teachers always deal with the reality that students are constantly being moved up the ladder "regardless of
what little they've done." Further, her version of tracking is especially beneficial for the average C student.

That's what I feel is the shape of the public school system as it is because we constantly move kids up. They come to us regardless of what little they've done or when they get here, they have to take basic algebra. And what happens to those kids that, the C kid that has been a constant C student throughout his career. He isn't ready for the normal algebra. That student can be held up because these other kids have no skills so he can't move on and then he dwindles off and we kinda lose him, too.

Attitudes

"Knowledge is the skill." Ms. Prahst disagrees with the idea that knowledge in school mathematics is always changing. She reasons as follows:

I think math is math. I think the actual knowledge there is always the same and it's gonna be there. What's changing is the approach, the technique. I don't think the knowledge is changing. It's just how we play the game differently but the same knowledge and structure is there.

So what does it mean, then, to know mathematics if it is static, that is, "math is math?" "I don't know," she responds.

I would like to think that no matter what approach I took, that they could measure an angle when they came out of geometry. That when they get out of algebra or the math modeling class, they could graph an equation or solve an equation or, you know, find points. Those are the kinds, ... the knowledge is the skill, regardless of how you take it to 'em. The knowledge is the skill, and they should be able to reproduce the skill regardless of what book you're using or anything else. They should come out with those skills, regardless of you're using technology or hands on or anything else. So that's what the knowledge is. So when you have a particular course, there are certain things that they should come out with regardless of how you would attack that. They should be able to do integers, that kind of thing.
Ferdie: You said you're not sure the math you teach is relevant to your students' lives.

Ms. Prahst: Only because I'm not sure what my students do in their lives, to be honest. And that's why I don't know that if what I am teaching is relevant. When you try to make it relevant into the future, ahm, for example, you'll need this in Algebra 2, you'll need when you go to college, or you'll need this ahm I'm not sure that they can think that far ahead to make it relevant. I can try to think I make it relevant, but I'm not sure they perceive it as being relevant because they can't think pass further than today. "Why are we doing this stuff today?" I tell 'em, sometimes, "I tell you probably will have children in school one day. Learn it for your children if it means nothing to you because there's nothing worse than your kid coming to you and you get frustrated because you don't remember the stuff, you know or you don't have the background for it. So you try to think of ways to make it relevant but you'd have to be in each individual situation and I'm not that clued in to that.

A.1.3 MR. JACK

Ferdie: Why do you think some students are resisting math or learning math?

Mr. Jack: I think some students are resisting anything expose to life. .... A lot of them are just content being a vegetable, you know, listening to their walkman and just existing.

Knowledge

Mathematical Background and Prior Meaningful Mathematical Experiences. In high school, Mr. Jack had a college preparatory mathematics background: "I took algebra, geometry, algebra 1 and algebra 2, college algebra, [and] trig[onometry]." In college, he started off majoring in industrial technology but after two years, switched over to physics. He graduated with a degree in physics, with a minor in mathematics and
industrial technology. The mathematics courses he took in college were calculus, analytic geometry, and differential equations.

Regarding his experiences as a mathematics student, Mr. Jack recalls his college mathematics teachers "lectured" a lot and emphasized "process versus memorization."

[By process] I mean you're given a problem. How are you gonna approach, how you're gonna attack, [and] how're you going to plan your solution. When you do a problem, you can explain the logic of the approach back to me or the part with one of your peers.

College math classes were "relatively small, so that was really good. ... (W)e used to have maybe twenty students in class." Mr. Jack believes he "tend[s] to teach the same way, unless you can explain what you don't know." Although he is not convinced that he has somewhat established his preferred teaching techniques years ago, he tends to characterize his teaching as about "transfer(ring) knowledge."

I think back in terms of the way I learned and I think in terms of learning styles. I think I continue to .. transfer knowledge the way that I was taught. But at the same time I attend workshops in terms of like the course I took on Cabri Geometry using the TI-82 or the TI-85 calculators. I expose myself to new technology and new techniques, too.

Current Teaching Load and Level of Satisfaction. At CHS where he has taught for five years, Mr. Jack teaches three Geometry (one for college prep students and the two others for noncollege prep students) and three Developmental Algebra (for noncollege prep students) courses. If given a choice, he prefers teaching the college preparatory mathematics tracks because "students [in those classes] are always more disciplined. They have a solid foundation to build on."

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9 Mr. Jack also holds a masters degree in health planning administration.
Perceptions Related to the School Math Curriculum. Regarding the school mathematics curriculum, Mr. Jack is "usually able to cover maybe two-thirds of the course." He does not get to cover the intended curriculum because of two factors that "really slow you down," namely: CHS's alarming rate of student absentees, and behavior problems. Mr. Jack finds himself in a paralyzing situation with regards to student absentees. He reasons as follows:

(You have like a 30% absenteeism right now on a regular basis. And that 30% that are absent may not be the same 30% all the time. .... Well, this schoolyear one of the priorities was improving school attendance. [But] school attendance hasn't improved that much.

Checking students' attendance usually takes longer than expected, Mr. Jack insists. Further, he claims that because of the student absentees, he never gets to completely cover the recommended curriculum.

It takes something that should take twenty seconds in terms of checking the attendance, [but] it takes a lot longer than that. So in a class time, you have kids that are trickling in late. You have to stop, adjust your records, and your rate in terms of checking the attendance is gonna be up because somebody might come in when your back's turned. All those things slow up the normal progression of things that you have to do in terms of what you plan to teach and accomplish during the given period. ... So whereas normally you might be able to have the expectation of covering 80% of the textbook, you might only be able to cover 50 to 60% of the material.

In a later interview, Mr. Jack provides another reason why he does not get to teach the entire intended curricula for those courses he teaches: It deals with the value he accords "basic information" such as, say, being able to solve linear equations more than anything:

My expectation at that base line level, if you don't learn anything else in this course, I want [students] to be able to manipulate algebraic equations. That's a part of algebra. Before we go on to polynomials, before we go on to quadratic formula, before we go on to graphing, we need to know the
concepts of equations, [of] balancing equations.

Mr. Jack argues that if students do not have a sufficient knowledge of the basic processes, then that could cause frustration on both sides: the teacher and the students themselves.

If they don't have that basic thing, then I feel that I'm going to be frustrated when I go on and nobody knows how to do these basic things. They're going to be frustrated much more than they are right now. And I'm gonna have even less success when it comes to the time at the end of the year when I give them a final and subject them to a test which is supposed to gauge the knowledge that's been transferred over the course of the whole school year. So I'm trying to avoid that, but again I believe it's better for them to learn and learn well the basic information than to fly through the course and for them to come out not knowing anything but just have some exposure, be able to say "Yes I've seen that before but I can't do it."

Teaching Mathematics in an Urban Setting. To teach mathematics at CHS, argues Mr. Jack, means to be responsible for materials students need for them to be able to do mathematics.

In terms of tools and equipments especially in geometry. The expectation was everybody would bring their own tools and equipment to the school, and we would carry them from class to class. Now that's not an expectation. I think that the kids expect the school to supply all these instruments and if they don't have those instruments, they don't do their homework. But again I think that has to do with the levels of kids that I have, too. Ah, both college prep as well as the regular track kids, kind of use school supplies rather than their own whereas, really, they should have their own at both settings, both at home as well as at school. You carry stuff back and forth. But that's not the case these days.

Perceptions About a Multiculturally-Based Mathematics Teaching and Learning.

What about the concern for race, culture, and gender in school math reform? Further, especially because there are more African Americans than Caucasian Americans in CHS (with a very small percentage of nonblack minorities) and Mr. Jack being an
African-American himself, I asked him if there is a need for a different approach to mathematics pedagogy? "No," he responds.

'Coz math is math! ... I don't see any need to make any kind of adjustment for culture, for cultural differences unless in terms of the spoken words or in terms other than that. Normally if I were teaching some Hispanic kids, there will be a significant adjustment in math to be made but in general, no, I don't see any difference of approaches.

Mr. Jack believes there is no need to be too concerned with gender differences, either:

I don't see any differences there either. I've seen girls that can be just as analytical and adept as guys. And even more so these days because girls tend to be more focused than the guys and serious about their studies in general.

Mr. Jack also thinks that his female students seem to perform better in his classes than their male counterparts.

Concerning multicultural mathematics, Mr. Jack does not see the need to "make any adjustments at all, really."

I think I've had occasionally Asian students who maybe recently emigrated to the country and I make adjustments for that. ... But other those kinds of minor adjustments, I don't think any really major adjustments for cultural differences. I may from time to time interject something regarding the culture of the ancient Greeks or something like that, in terms of pyramids or something like that or Archimedes. I might interject something like that from time to time.

Beliefs

Conception on the Nature of Mathematics. Mathematics for Mr. Jack is "using numbers, systems, and theories and concepts as it gets applied in everyday situations."

Mr. Jack believes that mathematics content has not changed, although "the textbooks are
a little bit different, color illustrations, more examples, [and] a little bit more user
friendly."

Model of Teaching and Learning Mathematics. Teaching mathematics for Mr.
Jack is "mak(ing) math fun." But "it is essential that kids know and understand some
basics" for math to be really fun. "If you don't know the basics, you're really restricted,
limited in terms of what you can do," Mr. Jack adds. In a later interview, he explains
situations in which mathematics can be made "fun:

(D)oing things that are almost like laboratory work, by playing with the
computers and calculators, and being able to apply mathematical concepts
to things that they [students] experience but maybe not think about in
everyday life, and tying in mathematics with science in terms of
integrating the two, the practical applications. [Further], just getting
them to understand new concepts, new ideas, and proving their ability to
analyze things.

The Use of Textbooks. Since students in CHS are tracked, Mr. Jack says there are
supposedly two sets of math textbooks for each level of algebra and geometry. But
because the college prep track textbooks are better organized, he uses the same material
for both levels he is teaching. He believes that those in the noncollege prep track can
understand material from the college prep course "if they put their minds to it."

I believe that the college prep textbooks for both algebra and geometry are
better written than the noncollege prep textbooks. So consequently for both
my algebra and geometry courses, I'm using the college prep textbooks other
teachers aren't to the extent that I am. But I have assigned them college prep
textbooks. The algebra textbooks that I'm using is the old textbook that's
been taken out of circulation in all the other schools. I have almost all the
copies here.
Further, Mr. Jack thinks that the presentation of the textbooks for the noncollege prep track is "out of sequence," "disjointed," and pursues concepts that are not "tied together" and "connected" well.

The newer textbook [for the noncollege prep track] has a *collage* approach. They're here, there, everywhere in terms of concepts. The concepts aren't tied together, everything is disjointed. Things are taught totally out of sequence and the students will have a hard time connecting things, especially if they don't have a common knowledge base.

The college prep textbooks, on the other hand, are more coherent and the sequence of concepts taken occur in a "logical progression."

Because of that, I think it's simpler for students to grasp and understand the concept that they take. Every chapter starts with a foundational level and builds from there, and for that reason, I feel the textbook, it's better written. I might have to go through it a little bit more, maybe my pace is slower in terms of covering the material .... With the geometry course, it's basically the same thing.

Mr. Jack also does not see the need to distinguish between math texts since the problem, according to him, is more internal (student motivation and discipline) than external (textbook).

The big thing is, with the noncollege prep students, their study habits aren't as good [as the college prep students]. They aren't as focused in terms of doing things like proof. You have to work through the lower attention span kinds of things and the lack of focus in terms of presenting the material. But if they put their mind to it, they can understand it. And I think the textbooks that are written for the non-college prep students, I think that's an excuse.

Again, Mr. Jack insists that "anybody and everybody can do" mathematics.

I believe anybody who wants to do algebra or geometry or college prep course can. It's just a matter of them being focused enough to put their minds to it. ... [Teachers] just need to .. get them [students] to glue their butts to the chair, sit down, listen, and make a good faith effort to understand. That's the whole ... problem more than anything else. Students, those
noncollege prep students, they don't have, they haven't been academically disciplined, basically.

*His View on Tracking.* When asked about his view on tracking, Mr. Jack say he is not sure whether or not tracking students based on tests and previous GPAs is effective:

A kid may not have, in terms of testing, ... the ability [to do] the college prep course, but that can be compensated by academic discipline and motivation if he has a will to do it.

*Technology as Being Unique to Mathematics Teaching.* For Mr. Jack, technology is unique to the discipline of school mathematics. So I asked him how has technology changed the existing school mathematics curriculum? He responds, as follows:

It hasn't changed the curriculum as much as we would've liked because we're kinda bogged down in terms of our class scheduling. I have 45 minutes per period. ... (T)ime constraints are really a hindrance in terms of doing more in way of integrating more technology in the classroom. You just don't have enough time. By the time you get the kids get settled down.. something starts and it's time you close out. .... That may change next year.

Logistics, Mr. Jack says, tend to influence the extent and full implementation of technology.

I haven't used Cabri more on computers with my geometry class ... because of the logistics of the situation. It's difficult. The computers are up here [in room 51]. Ms. Prahst's using that class eight period when I have my college prep geometry class, and I'm down there [in room 31]. I've brought 'em up here once, but again if it were more convenient to do, I'm sure I would have exposed [them] a lot more. But still I would have liked to use it more than what I have.

So in what way/s does he expect technology to change mathematics? Not in a revolutionary way but in terms of its "quick mechanism" capability, says Mr. Jack.

I think that you can be able to accomplish more. I think you'll be able to share
a lot more ideally with students and I can just compare like their experience and exposure to like a graphing calculator versus mine when I was in school and we had to do everything by hand. ... (P)ictures are worth a thousand words and I guess in terms of quickly having a mechanism where you can deal with theory and concepts through graphing calculators or you could expose kids to a lot more of things they can understand. They don't have to work 20 to 30 minutes in terms of generating a graph to see what it looks like. ... I just think that it has a higher impact and it really facilitates their grasp of the subject matter.

_His Thoughts on Block Scheduling._ By "next year" above, Mr. Jack means the school has decided to implement "block scheduling." Although Mr. Jack does not seem to be too optimistic about doing that since he believes that there are more fundamental issues of concern that the school is failing to address. He argues as follows:

(E)ven if the schedule kinda does change ..., I think the big thing for [it] to work is only gonna work if you get attendance problem under control and student behavior under control. Just because you have more time to do things, if the kids are still unruly, you're still not gonna get any thing done. ... So there's gotta be a tremendous change. A prerequisite to making anything work, no matter what kind of changes, is having kids learn some discipline in their lives."

_Perceptions About Reform, the Standards, and His Students._ Mr. Jack is well informed of current restructuring in school mathematics but he strongly believes that some suggestions made by the reform movement fails to make sense and do not fully address his concerns as a mathematics teacher in an urban setting. Regarding the Standards, he says:

The _Standards_ make sense ... in terms of having greater focus on analysis. That wasn't required as much before. I think there is more emphasis on analysis than on rote learning."
Concerning *constructivism*, he says implementing such "exercise" involves time which he seems not to have enough of in the present program. Mr. Jack says:

In terms of letting them discover concepts on their own? Again those kinds of exercises require time and time is one thing that under the current daily schedules, we don't have, okay?

Mr. Jack believes that students must be allowed to actively construct their mathematical knowledge but then again, he sees that as rather difficult to implement because students are not apt to the task. So many of the students he deal with daily "have a first grade mentality" and think in very simple terms which he find very frustrating. The statement below represents Mr. Jack's perception of the students in most of his classes.

It's just like learning how to ride a bicycle. You're gonna fall a few times. You get up, you get back on, you try to ride. You aren't going to succeed first time in anything, alright. So you have to be willing to have the quest, the thirst for knowledge and learning, to try and try again. A lot of these students aren't. [They] have kinda a first grade mentality in terms of all problems are very simplistic, have yes, no, true, false answers, and 2 plus 2 is equal to 4. Anything beyond that in terms of thinking, they don't wanna deal with. Life's not that way. Life is highly complex, and as they go on in upper grades of school, not only with math, science, but all other subjects, they can expect things to be more challenging. It will require them to analyze and think at a higher, more critical level and a lot of times, these students aren't used to that. They haven't been nurtured and brought along in the lower grades with that expectation. So by the time they get here, they don't have it and it's not something that's part of them.

Mr. Jack sees his role in more realistic terms: "(W)hat I had to try to do is make up three or four years in terms of changing or readjusting their attitude, their attitude towards school and towards work." But that is easier said than done> He feels students do not want to assume the responsibility for their own learning. Almost to the point of exhaustion, he keeps reminding his students that:
I can't spoonfeed you and for you to sit there and do nothing, just write on the board, and you got to do one problem and expect to do a test [you think you] will be able to do. It doesn't work that way. ... You have to have what I have on the board as a model in terms of doing your homework and you have to do it. If you don't do it, you aren't going to learn. And if you can't do it, you don't know.

*Perceptions About What Constitutes an Ideal Math Student, an Ideal Math Class, and a Mathematically Able Student.* For Mr. Jack, an ideal math student -- "they're rare" -- "aren't the brightest kids but they work hard and I guess that means a lot to me 'coz they're doing what they're supposed to do." He adds:

[It] is a student who comes everyday, who may run into barriers in terms of understanding but is focused and really makes a good effort and tries as hard as he can and do what he's supposed to do in class work and homework.

*Teaching Mathematics: Dealing With Student Resistance.* Mr. Jack thinks the problem of student resistance to mathematics is part of a larger problem: "They resist anything, exposure to life." Further, he believes that students' thoughts about the importance of education is tied to what their parents think of education.

I think it goes back to their home in terms of what parents specifically think of learning. Education isn't a priority to the parents, so it's not a priority to their kids. They are perfectly comfortable just existing. .... They won't try to do anything 'coz they don't want to get exposed to new concepts, ideas, or any thing. So a lot of them are just content being a vegetable, listening to their walkman and just existing. And it's kinda sad ... it's sad ... (W)ell, obviously they just don't have any curiosity or motivation and I think a lot of them again didn't receive proper nurturing in the formative years and that's why they're so dead as adolescents in terms of knowledge, curiosity about the world around them.

*Changing Views of Mathematics Teaching.* So how has mathematics teaching changed over the years for Mr. Jack? He thinks it is not the same as the time he started
teaching six years ago. Actually it has become less idealistic and more realistic. He reasons as follows:

Part of it is students, the whole teaching and school environment. School's not a priority to these kids, and it's about the bottom rung of the totem pole in terms of what their priorities are. So consequently the motivational level of students is low and they don't challenge each other.

He recalls his experiences in one of his geometry classes:

In geometry class, there (i)s pulling teeth in terms of going over in trying to apply this [proving using a T-column style]. There (are) side line conversations going on which I ha(ve) to curtail and it (i)s just like pulling teeth in terms of trying to get them to participate.

Principle of education. Mr. Jack does not exempt himself, of course. But successful teaching and learning, he thinks, occurs if there is a significantly strong and productive student-teacher conjunction. He uses the race metaphor in explaining the significance of commitment and the importance of good membership, as follows:

Okay, in terms of understanding and transmission of knowledge, some of that is from teacher to student. Okay that might be 60%. Okay, 20% might be one student challenging and pushing the other in terms of academic ability and study habits and taking on the challenge in terms of doing homework. And 10% might be something else. But because of the low motivational level, these kids, they don't challenge each other. It's just like run and track. If two members of the track team run for 40 and neither one of them puts their heart into the practice in terms of putting all of their own into it, then that's gonna affect their time, the time which they can, the minimum time that they can run that event. If they practice hard and run hard, they'll lower their time and they'll be competitive. .... And it's the same thing here in the academics, they don't challenge each other because and it has to do with the teaching environment. Those two things .. level of student motivation and competition, those things being low, whether you like it or not, either consciously or subconsciously, your standards are lower. Your standards and expectations are lower. You might wanna do everything that you can possibly can to maintain your standards ... to normative levels as compared to other schools. ... (T)his is the environment that we're dealing with. And what needs to happen is to really uplift the whole teaching environment.
**Other Concerns: Why He Does Not Do Collaboration.** Mr. Jack sees his current schedule as a hindrance towards doing collaboration:

My schedule is very different ... in that I'm in different rooms all the time. And that has an impact on the degree to which I collaborate. I have first and second period, I'm in room 61. No, first period I'm in 61. This [second period] is my conference period and I have two classes in room 71 third and fourth period. Sixth period I'm back here for a class. Eight period

I'm in [room] 31 which is in a different section of the building, down in the first floor in the English department. That's the geometry class, so I have to make provisions to have protractors, compasses, and all that crap down there if I'm gonna be using them. Then I'm back across the hall, in room 60, ninth period. Last year, I shared a room, my main teaching classroom, with Ms. Prahst and I had geometry classes then. We collaborated a lot in terms of discussing problems, covering materials, sharing ideas in terms of approaches to teaching and covering the material. This year, I can go a whole day without seeing Ms. Prahst 'coz I'm moving all the time. There are times when after the school day's over, I go over and talk to her a little bit. ...

**Attitudes**

Mr. Jack is not sure whether teaching creatively is all that important, under existing circumstances.

(You have to give consideration to the teaching environment in which you're dealing with. ... In terms of behavior, ... if you're being challenged because of attendance, because of behavior problems, to teach them the basic core curriculum and get that, you don't have time to be creative. All your energies are being spent in terms of trying to transfer just the mere minimum, essential information to them.

*But, in fairness to Mr. Rudd (pseudonym) who makes the schedules, this does not happen all the time. Mr. Jack says:*

(When the school year started, Mr. Rudd [said] that I was assigned a less desirable schedule than anybody else in the building. He apologized to me in terms of having to pick up my things and move from place to place as much.*

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Ferdie: You responded "not sure" to the item: "The goals and priorities of my department are clear." Mind expounding that a little bit more?

Mr. Jack: [The] kind of student that we have, the students that we have are different in terms of the backgrounds that they come from and their values, how they value education. And again this has to do with the question before in terms of expectations. Are your expectations high, low, or what and again, you have to consider what you're working with, in terms of the foundations that kids have when they come here as freshmen. And because kids [that] come to high school aren't as prepared as they should be before high school, I think that has ... kind of muddled priorities in terms of "this might be the expected standards, expectations of the curriculum." But those standard expectations may not be realistic in terms of the student population that we're working with because of the baggage that they come in the class with. So that affects the goals and priorities of the department. On paper, they might be here. In actuality, they might be there. But that's not really clearly stated or documented in any way.

A.1.4 MR. TAFT

Ferdie: Does the school math curricula revolve around your students' interests and background?

Mr. Taft: No, not really. Not for the lower achievers.

Ferdie: So how do you envision a curriculum that is suited to their flower achievers' interests?

Mr. Taft: We ought to be teaching the life skills they need, life skills they need for them to graduate, how to keep a check, income tax returns, payroll, all these things you know. I don't see the point in forcing so many stuff down the kids' throats when number one, they haven't been successful. ... And a lot of them will have parents who say, "You don't need that." So if the parents say you don't need that, forget it. It ain't gonna happen.

Knowledge

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Mathematical Background and Prior Meaningful Mathematical Experiences. In high school, Mr. Taft took the usual mathematics sequence: Algebra 1, Geometry, Algebra 2, and one semester of Trigonometry. He originally intended to be a history teacher, but "'it' and I didn't get along" in the early college years. So he pursued a different path, mathematics, wherein he "took every possible math course I could take." He completed 28 semester hours of mathematics consisting of: three courses of calculus, courses in advanced calculus, differential equations, modern algebra, and noneuclidean geometry.11

Current Teaching Load and Level of Satisfaction. At Copeland High School where he has taught for ten years,12 he teaches two Developmental Algebra (for noncollege prep students), two Algebra 2 and two Precalculus (both for college prep students) classes. Mr. Taft says that he is happy teaching the college prep track and is "frustrated in the [Developmental] Algebra A classes" because the students in the Algebra A classes "lack interest, a lack of desire to do anything." The lack of desire, he thinks, may have to do with their (repeated) experiences of failure.

Some of them never had success in math. Many of the kids I have, I would be almost willing to bet that anywhere from a third to a half in each of my three classes are repeaters. People who took it last year or the year before them are taking it again. So you know that doesn't help. They don't want you to know that they just haven't necessarily had a lot of success. They don't think that they're gonna have any success, therefore they don't want to make any effort to try.

11Mr. Taft also holds a M.Ed. in Mathematics Education.

12Mr. Taft has taught in an urban setting for almost thirty years.
Teaching Math in an Urban Setting: Dealing With Student Absentees. Like the three other teacher-participants in this study, Mr. Taft claims that mathematics teaching in an urban setting means learning to cope with an unusual number of student absentees.

You know it's a virtual impossibility to give it any kind of continuity when you can have a class of 30 to 35 kids, you have a third or more missing everyday and in five consecutive days, it's not the same third that's missing everyday. ... You have 30 kids on your roster and you see 20. Now if it were going to be the same 20 five days a week, then right or wrong, you don't worry about the other 10. You deal with the 20, you're done. But it'll be this 20 on Monday. On Tuesday, you still got 20, but three of the kids who were here yesterday are gone, and three of them that were absent are back. And on Wednesday, it will switch a couple more, and on Thursday, it will switch a couple more again. So other than my two precalculus classes, I would say that I could probably count on one hand the number of kids that have perfect attendance in each class.

Significance of Students' Socioeconomic Status. Mr. Taft is not sure whether the way he teaches mathematics may be different if his students were to belong to a higher socioeconomic status:

I really don't think it is. I mean I'm not sure .. only from the standpoint of maybe I don't expect as much. But I feel I'm still teaching the subject, the topics basically the same way I taught it the first time I started. It's still the same material. We haven't changed the math. 1 x 1 is still 1, 2 x 2 is still 4. So I don't think I've changed that.

Perceptions Related to the School Mathematics Curriculum. I asked Mr. Taft if, perhaps, one reason why students are usually absent and manifest a lack of desire to achieve success in the mathematics classroom deals with the idea that the school mathematics curriculum does not revolve around their interests and background? Mr. Taft argues in the affirmative, at least, for the "low achievers" in his classes. Although, in a later interview, he thinks he is unsure about what's relevant to them: "I mean what we
really probably need to be doing for 'em, we're not. Our hands are tied." He recalls a
time when the mathematics department at CHS thought about introducing a "life skills"
mathematics course for "a lot of our kids who are at-risk:"

They're not gonna make it, they're not gonna graduate. They would quit, get
kicked, whatever. And we felt at that time we thought that they ought, what
we really ought be doing, we ought to be teaching the life skills they need,
life skills they need for them to graduate: how to keep a check, income tax
returns, payroll, all these things you know. It was 9th grade general math,
10th grade math. And then we went to the reform panel. We finally got
what we agreed, that we could teach it. We had a class that literally dealt
with, you know, you got paid $2.95 an hour and you work 40 hours, how
much .. not only how much do they owe you to pay, but how do you lose it,
what's the federal tax versus the state tax, what is your takehome pay, all
that. And they finally said, "you can do it. We're not gonna provide you
with textbooks. So you gotta either buy your own textbooks, buy 'em
yourself, or you can actually xerox everything. You gotta make your own
materials." To top it all off, the kids are not allowed to count it as one of
the two math credits to graduate. Okay, I looked at the woman and I said,
"Our kids are at risk, they're not stupid. They still have to take math 1,
they still have to take math 2, they still have to pass 'em. And now you're
gonna tell 'em, 'Here's the third math class you can get for fun. That'll
teach you things you need to survive.'" They're willingly gonna take that?
I don't think so.

Although such course was approved, the reform panel asked them to "write the program"
(curriculum guides, course study, etc.) themselves. Such a math course was to be an
elective credit, but "they couldn't give it as a credit to graduate as one of the two math
courses." The mathematics department then thought it was a useless undertaking; "we
ended up not teaching it" since students would not "willingly step up to take a third math
class when they could take something like shop, or another third class as an elective.

We're not gonna have anybody. I mean it's a flat elective. You can't force anybody to
take it," Mr. Taft insists.
As for the privileged "upper level group," Mr. Taft thinks that "those groups that are going to Ohio State or like that,... I'm giving 'em a start. ... (I)t's giving 'em the background at least to be able to go on to the next step," and Mr. Taft adds, "if they go on to the next step."

Then I asked Mr. Taft about the significance of having two tracks in mathematics. Do noncollege prep track students, suppose after they complete the sequence, perform well in at least one college prep track course? It seems to me, I said, that the noncollege prep courses are really designed for something other than aid and remediation. The sequence is not rigorous, argues Mr. Taft.

If a student has Ds in Algebra 1, you could recommend him not to take geometry [but] "take geometry B [for noncollege prep students]." [But] (i)f a kid or his parents said they're taking geometry, they're in geometry. There's not a [policy]. That's just it. Students can go Algebra A, Geometry B, Mathematical Modeling C. They have not had a rigorous math class, not what I consider a rigorous method. Now they take Algebra 2. That's a leap of faith. I mean that's a big jump, really. Well, you saw today, that's the first day we actually started solving equations with some kind of rigorous look at it. Those are probably the hard ones we do. Two, maybe three, maybe a three-step process and that will be it in Algebra A. There's no factoring, none of that that you get in Algebra 1 that you need in Algebra 2. But students can go Algebra A, Geometry B, and Math Modeling C, and Algebra 2, 'coz I had [them]. I had two classes in Algebra 2 last year and I had, I'd say 6 to 7 kids in each class that did that.

Mr. Taft insists that noncollege prep students, even after finishing the sequence, may not be able to cope with the college prep track courses. "They couldn't. They just d(on't) have the background. I mean it's just that they're stuck." But some of those students in his Algebra 2 classes "stuck it out and a few have dropped. ... Well most of them stuck it
but they struggled, especially if it was doing anything that is expected to have been covered previously."

Beliefs

Conception of the Nature of Mathematics. For Mr. Taft, school mathematics has two levels and in which the higher level depends on the lower level. He says:

Lower level - add, subtract, multiply, and divide. The upper level, they deal more maybe with theory and concepts but again they need that foundation - add, subtract, multiply, and divide.

Mathematics, in general, for Mr. Taft is symbolic and static:

My subject, being math, the facts haven't changed. I mean it's not like we didn't get another set of dates. Another year didn't go by without more dates, or more items, or another war broke out or anything like that. Hey, you know as far as I know, sine $\theta$ is still opposite over hypotenuse. That's what it was when I was in school. The knowledge of the subject to me has never changed. It's still the same thing it was.

Mathematics for him is also "objective and not subjective," meaning to say that, "I don't have to grade, 'Well, what did they really mean by that?' I do give partial credit. It's just either right or wrong, if you look at it that way.

Model of Teaching and Learning Mathematics. Mr. Taft believes that the way he was taught mathematics and the way he teaches are somewhat the same, "well, maybe some." He shares his early mathematical experiences in the following way:

I don't remember there being a lot of original thought in the math classes I took other than the fact that some of the problems were tough, very rigorous, and much more rigorous than what we give to the kids nowadays.
To teach mathematics for Mr. Taft is to be a facilitator, "to show them methods, ways of getting results that are being asked for." But Mr. Taft thinks that he "has not had a situation" in which he would "walk in and say, 'Here it is' and they [i.e., students] go, 'Okay.'"

*Teaching Math in an Urban Setting: Dealing With Students' "Baggage."* Mr. Taft believes that teaching mathematics at this time in CHS means having to deal with classroom realities which have the effect of impeding learning and thus, causing the impossibility of teaching. He says:

> You have so much other stuff you have to deal with, the baggage and luggage from home, all of the problems in his neighborhood, the problems at lunchtime, all of these stuff coming into class, with this particular student or whatever, you can't slow down but it can impede the progress of that student.

Mr. Taft believes that all of these problems can be traced to the external "challenges" students are confronted with.

> Kids are faced with a lot more challenges today, outside of classroom than when I was in the classroom. And many of them are even faced with more challenges than when my sons were in the classroom, [and] (h)e's [i.e., one of his sons] still in the classroom [i.e., a college student]. I mean he's been out of the high school for three years. And it's just been three years. Things have changed. There's a lot of challenges that kids have to meet.

*The Objective and Perfect Nature of Mathematics as a Unique Factor in the Teaching of Mathematics.* I asked Mr. Taft if there is anything peculiar about school mathematics and the way it should be taught in the schools. Mr. Taft believes that mathematics has always been objective and "perfect:"

> I'm going along with the idea that ... math is very rigorous, precise, and
I can say the beauty of it is the fact that... there's no - well maybe - I mean it's concrete, it's there, here's the procedure, if you follow the steps, you come up with a solution. There's no interpretation, no rule. "What do they really mean by that," "did they really mean that that was that, or that was that," you know.

Mathematics being perfect and objective mean there is no need for students to "interpret what the teacher" is asking. Interpretation for Mr. Taft is related to how mathematical procedures are to be applied in the mathematical context. "There's no essay," he says.

There's no essay, I mean, there's no "Did I interpret what the teacher ask?" The student doesn't have to interpret what my question is in order to be able to do it. In some cases, they do, yah. They don't pick the right procedure and a lot of it is "This is what you do." "This is what you come up with." Whereas if they maybe don't understand what I'm asking, they can come up with a whole different slant on it. So did they not understand what I asked? Or did they not understand and just didn't write a full answer?

Mr. Taft reiterates his view of mathematics as perfect and almost always straightforward:

I guess I'm one of those people who like things to be perfect and math is that .. to me, it's not .. it doesn't have a lot of areas that are open to interpretation. You can't ... there might be more than one way to solve an equation but basically you're still solving the equation. It's not, "Gee, if I did this, I'll get this answer or I'll get this answer. Which one is it?"

Mr. Taft's view of mathematics influences the way he perceives assessment in the math classrooms. For him, open-ended questions are "not open-ended" in the real sense, that is, there is a unique item response -- "there is closure," in other words.

I know they talk about open-ended questions on the test. But with my tests, what few things I've seen, they're not open-ended questions. They're really not open-ended questions. It is an eligible choice. They get an answer and they have to fill it in themselves. It's not, "If you do this, you'll get this; if you do this, you'll get this." If the answer's 4.98, okay, they have to fill in 4.98 instead of A, B, C, D. It's not an open-
ended question. They may or may not get the right answer, but if it really was an open ended, there are answers. There is closure, there is an answer to this thing, you know. They just have to come up with it instead of saying, "Oh, it's A, it's B, it's C or it's D." Pick one.

I asked Mr. Taft if he has ever encountered a mathematical situation (problem, content, etc.) in which it became necessary to contextualize and to produce different interpretations, all of which made sense? Solutions can be different, he insists, but "not interpretation" in the real sense, of course.

I look to see what they [students] had. If they get the right answer, everything's fine, they get all the points. Maybe they made a mistake all the way down. I can give 'em credit to where they got there, to that point and, "Sorry, if you didn't get the rest of it" because a lot of kids make silly mistakes. They don't make precalculus mistake[s]. They make arithmetic mistake[s].

Perceptions About Reform and the Standards. Mr. Taft is aware of current restructuring in school mathematics such as the Standards and constructivism. Like Mr. Jack, he believes that some suggestions from the reform movement fail to make sense in his setting, or that they do not address some of his concerns as an urban mathematics teacher. Consider the idea of "algebra for everyone." He insists that "not everybody can."

I have a problem with [that]. Not everybody can. Not everybody, at least the ones I have, is going to be successful in taking algebra. Not algebra algebra, but watered down, milk run, whatever you wanna call it. Maybe they will, but the actual Algebra 1, the real, straightforward, hardcore Algebra 1, they don't have the prereq because they haven't had success with that and you know really that success has to be built not here.
Mr. Taft traces this belief on success early in a student's mathematical experiences — in elementary schooling. He seems adamant that if students have not had success by the time they get them in high school, "success can be very difficult" to achieve.

Reform Idea: The Impact of Technology in the School Math Curriculum. What about technology, especially because he uses them on not a few occasions in his precalculus classes? Although not too comfortable about its role in the mathematics classroom, Mr. Taft thinks that calculators tend to speed up mathematical learning by making the process of graphing more convenient. Students, according to him, "see it as saving some steps. ... (Y)ou don't have to do a thing. All you have to know is how to type it in. If you have a TI-92, you don't have to know how to factor anymore." Mr. Taft thinks, too, that technology has the power to change the focus of school mathematics.

To where, I don't know. It becomes a calculator class than it is a math class, now granted you still have to know what to do. You still have to know what to do. What you could, I suppose, conceivably end up having, you sit there and punch the keys on the calculator, if you got the right calculator.

Mr. Taft thinks of the growing influence of the calculator as being very much like the experience he has had the first time he was taught logarithms with logarithmic tables:

A couple of years ago, when I first saw logs with the log table, I thought that was the greatest thing since the slice bread. 'Coz we were doing, the teacher we had have been a college prof, and she came in and said, "Here's your assignment." And as it was .. back then, slide rule was it. There were no calculators, at least not common enough that anybody can afford to buy one. You know when she came in, [she said,] "I want you to find the answer to 295.7 to the fifth power times .000000692 to the fifth, divided by you know .. where do you slide? After doing that for a week, she says "Now, the reason I had you doing all those, I wanna show you this [a log table]. You can do this by adding or subtracting, you know, a little multiplication with your exponent. ... I can handle 5 times 4.9922 instead of having 25
digits trying to keep track of them. We've got it straight. We thought that was hilarious. I mean we can do add and subtract without multiplying and dividing anymore. But those are all gone because they're all in the calculator now.

_Perceptions About What Constitutes an Ideal Math Student, an Ideal Math Class, and a Mathematically Able Student._ For Mr. Taft, an ideal math student is a "self-motivated go-getter." Further, that ideal student possesses the following characteristics:

Somebody who wants to know how to do the problem, who wants to know a better way, maybe. Maybe [he] can get the problem whether [he] feels it's too difficult, it's taking too long. [He] wants to know [and you do] not just give 'em the answer. [He] wants to know if there is a better way to do this, "Can I?" Basically, [he] ha[s] to be very self-motivated and have a desire to know the outcome ... and not be put off or frustrated by incorrect [solutions].

Mr. Taft models his "ideal math student" based on his experience as someone who has successfully struggled through "a lot" of difficult moments.

I mention the time if I was put off or being frustrated by being in a math class, I wouldn't be teaching math 'coz I've had my frustrations a lot.

Mr. Taft thinks he does not have any ideal student in his lower level (nonprep) classes, "but that's why they're in the lower level." He has a few of them in his Algebra 2 class, but "they're sophomores and so, basically, they are more motivated." Motivation for Mr. Taft seems a function of school grade status and track: "The higher the level you go, the more motivation you have [and] you'll gonna meet."

_Perception About Group Work in the Math Classrooms._ Mr. Taft admits he has never tried any other method except for group work which he tried only a couple of
times. He finds it difficult to deal with the operational realities of, say, having a group with members of differing intellectual capacities. Also, group work for him may increase noise level in his classes, and that does not seem favorable to him because his goal "is to have them [i.e., his students] as quiet as possible."

I think that the group work to me is difficult because it has a tendency to lead to, not necessarily, but in a lot of cases it seems to lead to increase in noise level and ... I guess my aim is to have [them] as quiet as possible.

Group work for Mr. Taft would require students and their "teachers themselves" to be responsible and be "comfortable with the group concept" which he is not.

To me group work works fine if you can get everybody within the group to buy into it and to cooperate and to contribute. But if you're gonna have two kids in group 6, you're gonna have two kids in the group doing the work, two waiting until they get to copy the answer, and two who don't care. You know, it's not fair to the ones who are doing the work. And I know there's all sorts of you're supposed to .. you gotta impress on them, it's the group grade, and everything like that.

Finally, Mr. Taft shares his own personal experience as a parent when his son's teacher failed to employ the group work method properly:

I know situations in the past where a teacher has been taken to task because the child did the work was pulled down because of those who didn't. I had a real problem with that with my younger son. He was like in 6th grade, I think. The teacher was into this assertive discipline and collective punishment. One kid screw it up. So he made the whole class stay, stay after school for detention. I said, "Okay, one time." He did it once, and I had to go pick my son up and when I had to go pick my son up, I went it and had a little talk with the teacher. I said, "That's not fair. If you can identify the culprit and you're still punishing the group, that's wrong. And if you can't identify the culprit, you're still wrong for punishing the group because you weren't with them to catch what the kids were doing." And he says "I guess you could look at it that way. Yah, you're right." I said, "If it's my son, you give me a call, you let me know and it won't happen again." But I said, "It's not my son. Don't you dare punish him for your lack of competence or the fact that you don't
want to single out a particular kid and punish that kid." He never had
to say after school after, ever again.

Perceptions About a Multiculturally-Based Mathematics Teaching and Learning.

I asked Mr. Taft if mathematics teaching is affected by gender differences? Mr. Taft does
not think so. Concerning gender, he claims that girls perform better in his upper
mathematics classes and that there are less girls than boys in his lower level classes.

Males versus females. I have, as far as my class is concerned, the lower
level classes are predominantly male, the upper level math classes are
predominantly female. In my one precalculus class [there] is exactly
50-50. That supposed story that boys could do math so much better. In
my precalculus class, the better students are girls as a group. Individu­
ally, yah I suppose I could go back .. but I never worry about it, whether,
"Gee, the boys are doing better than the girls." My Algebra 2 class is
predominantly girls, and the better grades are coming from the girls.

Concerning race, Mr. Taft does not see any need to vary his teaching style. "I don't think
there should be," he insists. Mr. Taft claims that his grading is never influenced by it.

Personally I try to keep all my own when I do grades. I try to keep it. I
try not to look at the student as to who it is. It's just how many points
they get out of how many possible points for that student. I don't care,
whether it's a boy, girl, black, white, it doesn't make any difference. ...
If you got the points, you get the grade. ... I try to be very cognizant to
keep that out and I try to completely keep out any of my personal
feelings away from the grade.

Even with misbehaving students, Mr. Taft does not distinguish between troublemakers
from a particular race or culture, but "I will not bend over backwards to give 'em
[troublemakers] a better grade because of that fact."

Attitudes
**Attitude Towards Mathematics.** Mr. Taft thinks "it's so much nicer the fact" that
(school) mathematics "has not changed."

Right now I don't have to worry about the fact that this year 2 x 2 is 4, next year it's gonna be 5, the following year it's gonna be 3. Or you know there is very little, very little in that subject is based on subjectivity. It's all objectivity. There's no subjectivity. I mean I can give students partial credit on something, yes, if I want to. But if the answer's x = 5, it's x = 5! You know, how they got there could be different but still it's .. doesn't change. That problem with the answer x = 5, you ask that problem today it's x = 5, a month from now with the same problem, if you won't change the problem, the same problem, x is still 5, ten years from now, unless they do something really weird, that same problem, x will still be equal 5.

Mr. Taft thinks that the subject of mathematics is not cut and dry:

I don't think it is, but I enjoy math. I guess from the student standpoint, it is kinda cut and dry. But with precalculus, I enjoy that. ... Sometimes it's difficult to get that across to kids but I don't feel it's very hard, personally.

**Attitude Towards Teaching Mathematics: Issue of Creativity.** Mr. Taft is not sure whether thinking creatively is an important part of teaching and learning school mathematics. Students, according to him, have no need for it because he "basically .. lay(s) it all out" for them.

Thinking creatively, they [i.e., students] don't have to be, really. That's them versus me. They don't really have to think too deeply to be able to do the work. But if they're not there, that's where the problem is.

They don't need a lot of creative stuff on their part 'coz I try to .. basically ... lay it all out, "Here's what you do." So there's not a lot of creativity on their part.

What about the pedagogical aspect of creative thinking? I asked Mr. Taft if he finds himself needing to think creatively in the process of teaching/doing mathematics?
On my part, I sometimes ... I guess you could say it's a little creative to figure out a different way of approaching the same thing because the first way, or the second, the third, or the fourth way didn't work, or didn't work enough. So you try to come up with another approach. [But] you're limited ... there's just not too many ways you can do the problem. I mean if you're gonna add, you're gonna add. That's all you're gonna do, that's all you're gonna do.

Mr. Taft's main pedagogical technique of "transmitting" content is lecture. He disagrees with the practice of dialogue in the mathematics classrooms: "It's my approach to the way I teach it" and "it might be the way I learned it." Further, he says:

There is not much class discussion. So as far as needing to have class discussions in order to do some of the different things, it's not there in my classes. Some of the other math classes, it may be. But in mine, it's not.

Mr. Taft: I'm not sure I teach 'em how to learn. ... Everybody has their own learning patterns and I'm not sure. I may teach 'em how to do certain problems but how to learn, that's a loaded question. I'm not really sure. ... (I)f they recognize the problem, they can do it.

A.2 A Tabular Comparison of the Teacher-Participants' Responses to the Two Questionnaires

Table A.2.1 gives a summary of the teacher-participants responses to the Survey Questionnaire. Table A.2.2 gives a summary of their responses to the Grounded Survey.
### Table A.1 Results of Participant Questionnaire 1

**NOTE:** * means point of agreement

<table>
<thead>
<tr>
<th>Statement</th>
<th>Ms. Lynch</th>
<th>Ms. Prahst</th>
<th>Mr. Jack</th>
<th>Mr. Taft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The teachers in my department maintain high standards of performance for themselves.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>2. The teachers in my department push the students pretty hard.</td>
<td>Agree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>3. The department chair is interested in innovation and new ideas.</td>
<td>Not Sure</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>*4. I am continually learning and seeking new ideas.</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>5. I am granted a wide degree of individual autonomy in curriculum and course content.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>6. Students need to be assigned to specific courses based on tests and/or previous GPAs.</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Not Sure</td>
</tr>
<tr>
<td>7. My department offers different sections of most courses for students differing by achievement or ability.</td>
<td>Agree</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>*8. The principal sets priorities, makes plans, and sees that they are carried out.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>9. Students’ tardiness is a problem.</td>
<td>Strongly Agree</td>
<td>Disagree</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>*10. Students’ absence from class and/or turnover is a problem.</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>11. My teaching is affected by my students’ socioeconomic status.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Strongly Agree</td>
<td>Not Sure</td>
</tr>
<tr>
<td>12. My teaching may be different if my students belonged to a higher socioeconomic status.</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>*13. The textbooks we use in class are out-of-date.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>14. Large classes affect the way I teach, that is, the more students I have, the less efficient I feel about how I teach.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>15. Academic standards in my school are too low.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>*16. There isn’t much choice of teaching methods in my subject.</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>17. Thinking creatively is an important part of how and what I teach.</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
</tr>
<tr>
<td>*18. Knowledge in my subject is always changing.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>Statement</td>
<td>Ms. Lynch</td>
<td>Ms. Prahst</td>
<td>Mr. Jack</td>
<td>Mr. Taft</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-----------</td>
<td>------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>*19. The subject I teach is rather cut and dry.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>20. Class discussion in which students exchange views and ideas is an integral part of instruction in my subject.</td>
<td>Agree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>21. Instruction in my subject is most beneficial when students are grouped by prior academic achievement.</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>22. Students will learn more if they work together.</td>
<td>Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>23. No matter how hard they try, some students will not be able to learn aspects of math.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>24. Students need to write about their ideas in order to really understand math.</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Not Sure</td>
</tr>
<tr>
<td>25. I feel that it's part of my responsibility to keep students from dropping out of school.</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>26. If I had to choose, I would emphasize learning math content over personal growth for my students.</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Not Sure</td>
</tr>
<tr>
<td>*27. I believe that growth in students' self-esteem is as important as their academic achievement.</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>28. By trying a different teaching method, I can significantly affect a student's achievement.</td>
<td>Not Sure</td>
<td>Agree</td>
<td>Agree</td>
<td>Not Sure</td>
</tr>
<tr>
<td>*29. I work toward developing the skills needed for my students to become employable adults.</td>
<td>Agree</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>30. I believe that ethnic diversity in classes provide students a valuable learning opportunity.</td>
<td>Agree</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Not Sure</td>
</tr>
<tr>
<td>31. Academic excellence is my number one goal for students.</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>32. I established my preferred teaching techniques long ago.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>33. My expectations about how much students should learn are not as high as they used to be.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>34. Considering students' impressions about what they want to do later in life, I now cover less material and less difficult curriculum materials (e.g., textbooks, assignments) than I used to.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>35. The math I teach is relevant to my students' lives.</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>36. I teach students how to learn.</td>
<td>Agree</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Not Sure</td>
</tr>
<tr>
<td>37. I regularly give students the opportunity to explore</td>
<td>Agree</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
<td>Statement</td>
<td>Ms. Lynch</td>
<td>Ms. Prahst</td>
<td>Mr. Jack</td>
<td>Mr. Taft</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>--------------------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>38. I know a great deal about my students' families.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
<td>39. My homework assignments require students to think in</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
<td>new ways about what I have presented in class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*40. I sometimes feel it is a waste of time to try and do my</td>
<td>Agree</td>
<td>Strongly Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>best as a teacher.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41. Most of the students I teach are not capable of learning the</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>material I should be teaching them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42. I am certain I am making a difference in the lives of my</td>
<td>Not Sure</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
</tr>
<tr>
<td>students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43. If I try really hard I can get through to the most</td>
<td>Strongly Disagree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>indifferent or unmotivated students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44. There is really very little I can do to ensure that most of</td>
<td>Agree</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Not Sure</td>
</tr>
<tr>
<td>my students achieve at a high level.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45. The goals and priorities of my department are clear.</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
</tbody>
</table>
Table 5.2 Results of Participant Questionnaire 2

NOTE: * means point of agreement

<table>
<thead>
<tr>
<th>Statement</th>
<th>Ms. Lynch</th>
<th>Ms. Prabhst</th>
<th>Mr. Jack</th>
<th>Mr. Taft</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1. I teach math the way my own math teachers taught it.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>*2. The way I teach math has deteriorated somewhat over the years.</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>*3. I don’t teach math the way I want because of the attendance problem in my school.</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>*4. I find it difficult to employ group work and other activities because of the attendance problem in my school.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>5. I think school math is highly structured and continuous.</td>
<td>Disagree</td>
<td>Not Sure (Depends on teacher)</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>6. I do not employ group work and other activities because many students in my class are not capable of doing mathematics all by themselves.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>7. I think some suggestions from the reform movement in school math fail to make sense in my setting.</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>*8. Social class is not a major issue in mathematics teaching and learning.</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>*9. The belief of state department educators/specialists that all children will achieve at the same level at the same time does not make sense to me.</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>*10. I am well informed about the reform that is currently taking place in the discipline/subject of school math.</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>11. I believe that students must construct their own mathematical knowledge. But I also believe that I cannot wait forever for them to discover and to construct because we have too much to cover in so little time.</td>
<td>Agree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>12. Reform in school math at this time is not addressing my concerns as a math teacher in an urban setting.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>13. Time is a problem in the school math curriculum. I feel we cover too much in so little time.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>14. The math I teach prepares my students for college.</td>
<td>Strongly Disagree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Agree (Only the upper level classes</td>
</tr>
<tr>
<td>Statement</td>
<td>Ms. Lynch</td>
<td>Ms. Prahst</td>
<td>Mr. Jack</td>
<td>Mr. Taft</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>15. Considering the student culture in this school, I think some students are better off with a math course that will prepare them for work (e.g., consumer math).</td>
<td>Agree</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>16. I have a problem with the idea &quot;algebra for everyone.&quot; Of everybody, at least the ones I have, is going to be successful in taking algebra.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>*17. Race is not a major issue in mathematics teaching and learning.</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>18. I personally think that the concern for race, gender, and class matters, but that a lot of them is an excuse and people use it for an excuse.</td>
<td>Disagree</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>19. Math is symbolic, neutral, and context-free.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>*20. School math has always remained fixed and unchanging.</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>21. An ideal math student is willing to do the work, no matter what.</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>22. There are significant differences between students in the lower track and those in the college-bound track in the way they ask questions about math content.</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>23. I rely on textbooks a lot more than the prescribed math curriculum.</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>24. My students are prepared to tackle college level math courses.</td>
<td>Disagree</td>
<td>Agree</td>
<td>Disagree</td>
<td>Agree (Again only ones taking upper level classes)</td>
</tr>
<tr>
<td>25. I don't remember there being a lot of original thought in the math classes I took other than the fact that some of the problems were tough, very rigorous and much more rigorous than what we give to our kids nowadays.</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>*26. Gender is not a major issue in mathematics teaching and learning.</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>27. I do not know why many students resist learning math.</td>
<td>Agree</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>28. The math I teach my students do not revolve around their interests.</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>Statement</td>
<td>Ms. Lynch</td>
<td>Ms. Prahst</td>
<td>Mr. Jack</td>
<td>Mr. Taft</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-------------</td>
<td>--------------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>29. The math we teach our students do not revolve around their backgrounds.</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
<tr>
<td>30. When a prescribed way of doing a certain process in mathematics appears different from my own way of doing it, I tend to teach the prescribed way.</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>31. The kinds of questions my female students ask are somewhat different from the kinds of questions my male students ask.</td>
<td>Disagree</td>
<td>Not Sure (Never Noticed)</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
<td>32. Making math fun requires that students know and understand some basics, just like anything else.</td>
<td>Disagree</td>
<td>Agree</td>
<td>Strongly Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>33. The mathematical truths I teach will always be true, independent of time.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>34. Teaching math involves acculturating students to particular ways of knowing and thinking about mathematical content and processes.</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>35. In math teaching, it used to be that the concern was on skills. Now the concern is the use of math in science and/or in daily life.</td>
<td>Not Sure</td>
<td>Agree/Not Sure</td>
<td>Agree</td>
<td>Disagree</td>
</tr>
<tr>
<td>36. I think that discovery learning in math is not all that useful because students can't seem to make the transition from discovery to solving textbook problems on their own.</td>
<td>Disagree</td>
<td>Agree (But it forces them to think)</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>37. The nature of school mathematics is changing because textbooks are changing (in terms of scope, content, nature of content, sequence, focus, etc.).</td>
<td>Agree</td>
<td>Disagree (The reverse is true.)</td>
<td>Agree</td>
<td>Agree</td>
</tr>
<tr>
<td>38. A clear understanding of math involves being faithful to how rules and procedures work. It doesn't matter if sometimes they don't seem to make sense because they have been verified.</td>
<td>Disagree</td>
<td>Agree/Not Sure</td>
<td>Agree</td>
<td>Disagree</td>
</tr>
<tr>
<td>39. I feel I work in isolation most of the time because there are very few math departmental meetings and not enough collaboration with the other math teachers.</td>
<td>Disagree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
<td>40. When I teach math, I tend to instruct by telling my students how certain processes ought to be done.</td>
<td>Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Agree</td>
</tr>
</tbody>
</table>
Appendix B

First Interview Protocol

1. Tell me something about your early mathematical experiences. How were you taught mathematics in high school and in college? Do you see any similarities/differences between the way you were taught math and the way you teach math?

2. What is mathematics for you?

3. What mathematics subjects do you teach? Are you happy teaching those subjects? Why or why not?

4. Are you familiar with current reforms in school mathematics such as constructivism? How do you make sense of it?

5. Does the school math curriculum revolve around your students’ interests and background?

6. How is it like to teach math in an urban setting?

7. Is/Should mathematics teaching (be) influenced by issues of race, culture, and gender?

8. What do you think of group work?

9. What is your ideal math student? An ideal math class? Do you have that now? Has your perception about students improved or declined over the years? Please explain.

10. Has math teaching changed over the years? In what ways?
Appendix C

Second Interview Protocol

1. Can you talk about those items from the survey questionnaire in which you responded “not sure?”

2. What is important for me to understand about you as a mathematics teacher here in CHS?

3. Are there things that I may have missed, may have failed to ask, and that you want to talk about?
Appendix D

Membercheck Protocol

1. You were given two weeks to read the case study I wrote about you. Are there concerns or matters from the write-up that you want us to talk about? Do you think the write-up was fair to you?

2. Suppose you step back and pretend that you are someone else reading your case story, how would you react to her/his story?

3. Are there things that I may have missed that you want me to mention in the story?
Appendix E

Mathematics, Science, and Technology Education
School of Teaching and Learning
College of Education
The Ohio State University

Teacher’s Beliefs, Expectations, and Practices Survey

Participant Questionnaire

Directions

Please respond to the questions contained in the questionnaire as honestly as possible. This information will be used in addition to materials from the personal interview and on-site observations throughout the 10-week project. All information will be kept ABSOLUTELY CONFIDENTIAL. In the write-up of the findings of the study, your name will never be associated with material from this questionnaire or any other component of this project (e.g., personal interviews, observations).

Thank you.

Rivera Dissertation Project 978
PART ONE

1. What is your marital status (please check one)?
   (  ) Single
   (  ) Married
   (  ) Other

2. Please check the appropriate range for your age?
   (  ) 20-29
   (  ) 30-39
   (  ) 40-49
   (  ) 50-59
   (  ) Above 60

3. How do you describe your race/ethnicity? Please write on the blank below.

   ___________________________________________

4. Which of the following degrees do you hold? (Please circle all that apply.)

   B.A.   B.Ed.   B.S.   M.A.T   M.A.   M.S.
   M.Ed.   Ed.D.   Ph.D.   Other
5. Which best approximates your annual salary (please check one)?

(  ) Under $20,000
(  ) $20,000 - $29,999
(  ) $30,000 - $39,999
(  ) $40,000 - $49,999
(  ) $50,000 - $59,999
(  ) $60,000 and over

6. Please list all professional organizations in which you are a member and any office/s held.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
### PART TWO

**Directions:** For each statement below, please encircle the appropriate response.

<p>| | | | | | |</p>
<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>1. The teachers in my department maintain high standards for themselves.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>2. The teachers in my department push the students pretty hard</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>3. The department chair is interested in innovation and new ideas.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>4. I am continually learning and seeking new ideas.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>5. I am granted a wide degree of individual autonomy in curriculum and course content.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>6. Students need to be assigned to specific courses based on tests and/or previous GPAs.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>7. My department offers different sections of most courses for students differing by achievement or ability.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>8. The principal sets priorities, makes plans, and sees that they are carried out.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>9. Students' tardiness is a problem.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>10. Students' absence from class and/or turnover is a problem.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>11. My teaching is affected by my students' socioeconomic status.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>12. My teaching may be different if my students belonged to a higher socioeconomic status.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>13. The textbooks we use in class are out-of-date.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>14. Large classes affect the way I teach, i.e., the more students I have, the less efficient I feel about how I teach.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>15. Academic standards in my school are too low.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>16. There isn't much choice of teaching methods in my subject.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>17. Thinking creatively is an important part of how and what I teach.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>18. Knowledge in my subject is always changing.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
<tr>
<td>19. The subject I teach is rather cut and dry.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td></td>
</tr>
</tbody>
</table>
20. Class discussion in which students exchange views and ideas is an integral part of instruction in my subject.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
21. Instruction in my subject is most beneficial when students are grouped by prior academic achievement.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
22. Students will learn more if they work together.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
23. No matter how hard they try, some students will not be able to learn aspects of math.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
24. Students need to write about their ideas in order to really understand math.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
25. I feel that it's part of my responsibility to keep students from dropping out of school.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
26. If I had to choose, I would emphasize learning math content over personal growth for my students.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
27. I believe that growth in students' self-esteem is as important as their academic achievement.  

   | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |
---|----------------|-------|----------|----------|-------------------|
28. By trying a different teaching method, I can significantly affect a student's achievement.  

<p>| Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |</p>
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>29. I work toward developing the skills needed for my students to become employable adults.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>30. I believe that ethnic diversity in classes provide students a valuable learning opportunity.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>31. Academic excellence is my number one goal for students.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>32. I established my preferred teaching techniques long ago.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>33. My expectations about how much students should learn are not as high as they used to be.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>34. Considering students' impressions about what they want to do later in life, I now cover less material and less difficult curriculum materials (e.g., textbooks, assignments) than I used to.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>35. The math I teach is relevant to my students' lives.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>36. I teach students how to learn.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>37. I regularly give students the opportunity to explore math on their own.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>38. I know a great deal about my students' families.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Question</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>39. My homework assignments require students to think in new ways about what I have presented in class.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>40. I sometimes feel it is a waste of time to try to do my best as a teacher.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>41. Most of the students I teach are not capable of learning the material I should be teaching them.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>42. I am certain I am making a difference in the lives of my students.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>43. If I try really hard I can get through to the most indifferent or unmotivated students.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>44. There is really very little I can do to ensure that most of my students achieve at a high level.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>45. The goals and priorities of my department are clear.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
</tbody>
</table>
Appendix F

Mathematics, Science, and Technology Education
School of Teaching and Learning
College of Education
The Ohio State University

Participant Questionnaire 2
(Grounded Survey)

Directions

Please respond to the questions contained in the questionnaire as honestly as possible. This information will be used in addition to materials from the personal interview and on-site observations throughout the 10-week project. All information will be kept ABSOLUTELY CONFIDENTIAL. In the write-up of the findings of the study, your name will never be associated with material from this questionnaire or any other component of this project (e.g., personal interviews, observations).

Thank you.

Rivera Dissertation Project 987
PART ONE

1. What was your undergraduate degree major? Please write on the blank below.

                                     
If applicable, what is (are) your graduate degree specialization(s)? Please write on the blank below.

                                     
2. In what year were you born? ______

3. How many years have you taught at Copeland High School (CHS)? ______

   How many years have taught in an urban setting (including those years spent at CHS)? ______

4. To assure anonymity and absolute confidentiality in the writing and the reporting of data, by what name (alias) do you prefer to be known? Please write on the blank below.

                                     

**PART TWO**

**Directions:** For each statement below, please encircle the appropriate response.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I teach math the way my own teachers taught it.</td>
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<tr>
<td>2. The way I teach math has deteriorated somewhat over the years.</td>
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<tr>
<td>3. I don't teach math the way I want because of the attendance problem in my school.</td>
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<tr>
<td>4. I find it difficult to employ group work and other activities because of the attendance problem in my school.</td>
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<tr>
<td>5. I think school math is highly structured and continuous.</td>
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<tr>
<td>6. I do not employ group work and other activities because many students in my class are not capable of “doing” mathematics all by themselves.</td>
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<td>7. I think some suggestions from the reform movement in school math fail to make sense in my setting.</td>
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<tr>
<td>8. Social class is not a major issue in mathematics teaching and learning.</td>
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</tbody>
</table>
9. The belief of state department educators/specialists that all children will achieve at the same level at the same time does not make sense to me.

10. I am well informed about the reform that is currently taking place in the discipline/subject of school math.

11. I believe that students must construct their mathematical knowledge. But I also believe that I cannot wait forever for them to discover and to construct because we have too much to cover in so little time.

12. Reform in school math at this time is not addressing my concerns as a math teacher in an urban setting.

13. Time is a problem in the school math curriculum. I feel we cover too much in so little time.

14. The math I teach prepares my students for college.

15. Considering the student culture in this school, I think some students are better off with a math course that will prepare them for work (e.g., consumer math).
16. I have a problem with the idea "algebra for everyone." Not everybody, at least the ones I have, is going to be successful in taking algebra.

17. Race is not a major issue in mathematics teaching and learning.

18. I personally think that the concern for race, gender, and class matters, but that a lot of that is an excuse and people use it for an excuse.

19. Math is symbolic, neutral, and context-free.

20. School math has always remained fixed and unchanging.

21. An ideal math student is willing to do the work, no matter what.

22. There are significant differences between students in the "lower track" and those in the "college-bound" track in the way they ask questions about math content.

23. I rely on textbooks a lot more than the prescribed school math curriculum.

24. My students are prepared to tackle college level math courses.
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<tr>
<td>25. I don't remember there being a lot of original thought in the math classes I took other than the fact that some of the problems were tough, very rigorous and much more rigorous than what we give to our kids nowadays.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
<td></td>
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</tr>
<tr>
<td>26. Gender is not a major issue in mathematics teaching and learning.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
<td></td>
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</tr>
<tr>
<td>27. I do not know why many students resist learning mathematics.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
<td></td>
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</tr>
<tr>
<td>28. The math I teach my students do not revolve around their interests.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
<td></td>
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</tr>
<tr>
<td>29. The math we teach our students does not revolve around their background.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
<td></td>
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</tr>
<tr>
<td>30. When a prescribed way of doing a certain process in mathematics appears different from my own way of doing it, I tend to teach the prescribed way.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
<td></td>
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</tr>
<tr>
<td>31. The kinds of questions my female students ask are somewhat different from the kinds of questions my male students ask.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
<td></td>
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</tr>
<tr>
<td>32. Making math fun requires that students know and understand some basics, just like anything else.</td>
<td>Strongly Agree Agree Not Sure Disagree</td>
<td>Strongly Disagree</td>
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<tr>
<td>33. The mathematical truths I teach will always be true, independent of time.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
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</tr>
<tr>
<td>34. Teaching math involves acculturating students to particular ways of knowing and thinking about mathematical content and processes.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
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<tr>
<td>35. In math teaching, it used to be that the concern was on skills. Now the concern is the use of math in science and/or in daily life.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
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</tr>
<tr>
<td>36. I think that discovery learning in math is not all that useful because students can't seem to make the transition from discovery to solving textbook problems on their own.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. The nature of school mathematics is changing because textbooks are changing (in terms of scope, content, nature of content, sequence, focus, etc.).</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>38. A clear understanding of math involves being faithful to how rules and procedures work. It doesn't matter if sometimes they don't seem to make sense because they have been verified.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
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</tr>
<tr>
<td>39. I feel I work in isolation most of the time because there are very few math departmental meetings and not enough collaboration with the other math teachers.</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Not Sure</td>
<td>Disagree</td>
</tr>
</tbody>
</table>
40. When I teach math, I tend to instruct by telling my students how certain processes ought to be done. | Strongly Agree | Agree | Not Sure | Disagree | Strongly Disagree |


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