SOCIOCULTURAL CONTEXT OF YOUNG ADOLESCENT GIRLS' MOTIVATION FOR SCHOOL MATHEMATICS: AN ETHNOGRAPHIC CASE STUDY

by

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(Under the direction of Dr. Laurie E. Hart)

ABSTRACT

This is an ethnographic case study examining the sociocultural context of young adolescent girls' motivation for school mathematics. In particular, I explored various sociocultural influences, such as the impact of class, ethnicity, gender, and instructional structures and practices in school, on their motivation. Data were derived from regular observations in one school of two sixth grade mathematics classes, one advanced and the other regular, and repeated interviews with seven female students and their mathematics teacher. I also used archival data obtained from the participating students, teacher, and many others, including school administrators.

The data analysis portrayed contrasting pictures of young adolescent girls who came from different ethnic, economic, and cultural backgrounds. Even though they shared the same mathematics teacher and school environment, their experiences with school mathematics significantly diverged from one another's. In general, findings from this study reveal the profound impact of social/cultural capital upon the girls' experiences with school mathematics, as well as their construction of identities in the discipline.

One of the central themes that emerged from this study is a conflict between different ways of structuring and practicing school mathematics. The participating girls responded differently to the cultural environment of their mathematics classroom, and the ideologies that structured interpersonal relationships and ways of mathematics learning in the space. As a whole, their mathematics classes reflected the "justice principle," which emphasized a clear representation of rules, and equal applications of those rules for disciplinary and instructional

purposes. Rewards and punishments were given as consequences of an individual's attitudes and behaviors. Yet, girls from minority and working class backgrounds deeply doubted the fairness of such classroom and school practices and felt troubled with the justice principle. Based on their lived experiences of unjust justice at the school and other places, these girls rather advocated "an ethic of care" as a primary principle in their mathematics classroom: Through the ethic of care the girls highlighted mutual responsibility for each other, particularly those vulnerable and most in need, and contextual understanding of each situation rather than blind impartiality.

Though located under the influx of various sociocultural forces, girls in this study were not mere scapegoats of negative or unfavorable social influences from outside, but active agents who voluntarily chose an ideology that seemed to best benefit themselves. Each participant showed the unique interrelationships and dynamics among the various cultural ideologies she was exposed to, subscribed to, elaborated on, expanded, or resisted in their everyday lives. Their multi-layered, sometimes contradictory, voices reflected their deeply embedded desires and hopes as well as their ongoing struggles to move toward a possible model of learning mathematics that had not yet been actualized in their realities.

INDEX WORDS: YOUNG ADOLESCENT GIRLS, MOTIVATION, MATHEMATICS EDUCATION, CRITICAL THEORY, BAKHTINIAN THEORY

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DEDICATION

Dedicated to three extraordinary women in my life whom I aspire to emulate:

My mother, Myung-sook Kim

who taught me the impetus of my life should and could be nothing but love;

Sandy B. DeCosta

who inspired me to see the beauty and preciousness of women's courage and self-determination;

and

Laurie E. Hart

whose ethic of care always made a huge difference in people's lives, including mine.

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CHAPTER 1

INTRODUCTION

Relatively low achievement of female students in mathematics has been a concern to educational researchers and school practitioners. Several studies, including the results from the Third International Mathematics and Sciences Study (TIMSS) reported that female middle and high school students score lower than their male counterparts (Beaton et al., 1996; Crosswhite et al., 1986; Halpern, 1986; Maccoby & Jacklin, 1974; National Science Foundation, 1990). Gender differences in mathematics achievement, as reported in these studies, are small or not statistically significant in elementary grades, but become more clear and consistent as students move up to higher grades. The most recent mathematics data from the National Assessment of Educational Progress (NAEP) showed that gender differences in mathematics achievement are also problematic at the elementary school level (Ansell & Doerr, 2000). Research has also shown that mathematics achievement of female students is significantly influenced by age, ethnic group, and socio-economic status (SES) (Beaton, et. al., 1996; Crosswhite et al., 1986, Fennema & Hart, 1994: Leder, 1990). Interestingly, some educational researchers exploring the causes for gender differences in mathematics achievement, have revealed that female students' motivation and belief systems in the mathematics domain are somewhat different from those of male students (Eccles, 1984; Ethington, 1991, 1992).

Various perspectives have been introduced into the educational research circle in order to explain the gender differences in students' motivation and mathematics achievement. For example, a group of researchers has revealed that mathematics teachers' interactions with students are often related to student gender, providing different kinds of feedback and treatment to boys and girls (Armstrong, 1982; Becker, 1981; Boswell, 1985; Brush, 1985; Hart, 1989; Koehler,

1990). Furthermore, Atweh, Bleicher, and Cooper (1998) have found that mathematics teachers' interactions with male and female students vary depending on students' ethnicity and SES. Researchers argue that mathematics teachers provide female students with unfair or unequal treatment that helps to perpetuate gender inequity in mathematics. They explain that teachers, one of the most important socializing agents to students, are not free from various sociocultural influences and, therefore, impart hidden messages of mathematics as a male domain to their students.

Based on the findings in previous studies, researchers now acknowledge that gender differences in mathematics is a rather complicated phenomenon that may be related to various sociocultural factors in and out of the school system (e.g., Reyes & Stanic, 1988). In fact, numerous studies have reported that the perception of an individual learner plays a critical role in his or her actual academic performance (e.g., Wigfield, 1994; Wigfield & Eccles, 1992). Future choice and students' beliefs about their ability and value of mathematics learning are greatly influenced by various sociocultural factors such as ethnicity and SES. Therefore, researchers have often expressed a need for research examining the sociocultural context of mathematics learning which helps us explain gender differences in students' perceptions and beliefs. In particular, educational researchers believe that clarification of the ways in which various sociocultural factors or forces influence an individual learner's value, self-concept, motivation, and attitude toward the subject is very important in order to reach a deeper understanding of gender issues in mathematics education (Hart & Allexsaht-Snider, 1996).

Despite the richness of previous research as well as the acknowledged needs for research on sociocultural context of gender inequities in mathematics learning, the actual number of studies in this category has been very limited. As Atweh et al. (1998) argued in their recent article the social context of mathematics learning has been largely ignored in the literature partly because of the predominance of psychological approaches to students' motivation. The majority of previous research on motivation was primarily based on psychological approaches that emphasized

cognitive processes and characteristics of individual learners. Researchers in this tradition (e.g., Meece, Wigfield, & Eccles, 1990) focused on the internal relationships between various motivational constructs and beliefs as well as actual achievement and achievement behaviors of individuals. This type of research made a great contribution to our understanding of students' motivation in mathematics, but it has been criticized for neglecting sociocultural aspects of students' motivation as well. In fact, many studies that succeeded in revealing gender differences in male and female students' motivational constructs and learning behaviors failed to explain the structures and processes that actually caused such differences. Few researchers have investigated the ways in which female students perceive and understand the direct or indirect sociocultural influences upon themselves in relation to mathematical learning. As a result, little is known about the micro-level processes though which female students construct or deconstruct their motivation for mathematical learning as well as the larger sociocultural context that nests the micro-processes.

Recently, educational researchers have begun to pay more attention to sociocultural issues in students' motivation, revising previous understanding and research methodologies. Specifically, works of educational ethnographers and qualitative researchers have shed light on the issues of gender differences in mathematics education. Unlike traditional motivational researchers, they emphasize the importance of social context in understanding student motivation (Moody, 2001; Oldfather & Dahl, 1994). Educational ethnographers and qualitative researchers are primarily interested in the micro-processes of phenomena, such as the perceptions of people who are involved in a situation, in relation to the larger sociocultural context of the phenomena. Through close observation of micro-processes in classroom settings or in-depth interviews with participants, these researchers try to illuminate the deep-seated causes and actual processes of gender differences in mathematical learning and their sociocultural milieus (Erchick, 2001; Smart, 1996). Therefore, the main concerns of these researchers are why and how female students react to, participate in, or resist the construction of gender differences in mathematics learning

and how various sociocultural forces interact with this entire process in a specific sociocultural context. The purpose of this study was to examine the sociocultural context of young adolescent girls' motivation for learning school mathematics using an ethnographic case study design. In particular, I explored the impact of class, ethnicity, gender, and instructional structures and practices in school, on young adolescent girls' motivation for learning school mathematics by analyzing the complexity and dynamics of various cultural ideologies that compete with one another in their everyday lives.

Research Questions

This study centers around one primary research question. Several sub-research questions are derived from the primary question in order to guide the inquiry throughout the study. Each sub-question is framed to generate important supporting data to answer the primary research question.

Primary Research Question

What is the sociocultural context of young adolescent girls' motivation for learning school mathematics?

Sub-Questions

- What kinds of sociocultural factors or forces positively or negatively influence young adolescent girls' motivation for learning school mathematics? How do those sociocultural factors or forces contribute to or undermine young adolescent girls' motivation for learning school mathematics?
- What kinds of sociocultural factors and forces are reflected in the everyday mathematics classes of young adolescent girls? How do those factors and forces affect girls' motivation for learning school mathematics?
- What are the interrelationships and dynamics among the various sociocultural factors and forces, different ideologies and voices which impact the girls' motivation for learning school mathematics?

- How do young adolescent girls react to, respond to, or resist the sociocultural influences, developing their own identity in the mathematics domain?

Research Design, Data Collection, and Analysis

This study explores the sociocultural context of young adolescent girls' motivation for learning school mathematics. In order to best answer the primary research question, I framed this study as an ethnographic case study. Case study design is widely used in educational research, particularly for the investigation of a complicated phenomenon that involves various factors (Merriam, 1998). Since I am looking at the complexity of sociocultural context of students' motivation within mathematics classes, I believe that case study design is one of the best matches to my inquiry. I employed three data collection methods widely used in ethnographic studies; observation, interviews, and archival strategies (Hammersley & Atkinson, 1993). The constant comparative method was used for data analysis (Glaser & Strauss, 1967, pp. 101-115).

Subjectivity Statement

Many qualitative researchers acknowledge that their research is affected by their political standpoint: Research is never free from the researcher' biases that are deeply embedded in his or her consciousness. Therefore, it is highly recommended that a researcher, in the beginning of his/her qualitative inquiry, reflects on his/her subjectivity and brings his/her various biases to the fore as a way of facilitating critical reflections on his/her own research process. Following the suggestion, I will here describe my personal and professional journey up to the point where I became interested in these specific issues in education and, at last, decided to work on these research questions as my dissertation study.

Let me start with my reflection on the very purposes of research. Why do I want to do research? As Maxwell mentioned in his book, personal values and identity are important factors in qualitative research (Maxwell, 1996). I am interested in gender issues and student motivation in mathematics education. I chose this research topic because I want to do research that intends to transform people's lives in society for the better. This desire of mine was not derived from

metaphysical contemplation but rather from my own life experiences. I was born in a small town in South Korea, and raised in a very traditional family. My parents wanted me to be a teacher, which might have been the best job they could think of for their daughters. My parents were not happy when I chose the science stream in high school. It did not matter how much I loved mathematics and science. My parents believed mathematics and science held no promising future for good girls. It did not take long until I found my parents were very right. I continually witnessed that my female friends pursuing science-related professions suffered from various social prejudices and failed, in the end, in the male-dominated disciplinary areas. I felt sad, even angry, for my friends. I still feel a kind of loss inside myself since I gave up a part of myself under the unfavorable social circumstances. Now as an adult who is able to reflect on my previous life and to redefine the real problem, I want to make a change in this area. This is the main reason why I am now interested in social and cultural influences on student motivation in relation to gender differences in mathematics and science education. Since gender inequity in mathematics and science is problematic both in the United States where I am currently pursuing the degree, and Korea, I believe that my inquiry will be worthwhile and contribute to educational literature in both countries.

I acknowledge that my subjectivity plays a critical role not only in selecting my research topic, but also in elaborating my theoretical framework for this investigation. I think that the theoretical background of a study plays two roles at the same time: It helps the researcher build up her own understanding of the phenomenon under investigation; Also, it provides a foundation on which the researcher can argue that his or her suggested inquiry is necessary, legitimate, and important. The theoretical framework mediates the researcher's personal desire to understand a particular social and cultural phenomenon, and the authority of academic discourses historically and socially constructed in society. The researcher's personal research interest becomes to have a public value when he or she persuasively argues the importance of the problem, which the researcher's inquiry is directed, and the legitimacy of his or her approaches to the problem.

One of the most important facts here is that there is so much previous research, and, more importantly, a number of approaches that explain the same social phenomenon. A researcher has to choose a limited set of ideas and concepts from the plethora of theories, and what the researcher chooses as his/her theoretical window depends on the researcher's own subjectivity, values, and belief system. This is one of many reasons explaining why absolutely value-free research cannot exist in any disciplinary areas, including qualitative educational research.

I want to clarify that my way of looking at gender issues in mathematics is largely influenced by critical theory and feminist perspectives that have been incorporated with social constructivists' revision of human motivation. It is not by accident that I subscribe to these theories for my research. Through my experience as a woman and teacher for working class children in a large metropolitan city, I have come to believe that those theories are most powerful in explaining various aspects of social inequality, including gender inequity, and offer me a vision or hope for transformation in the future.

I absolutely agree with Fine's statement; "I do this (research) because I believe intellectuals carry a responsibility to engage with struggles for democracy and justice" (Fine, 1994, p. 31). I am sensitive to power issues between the people inside and the people outside, in other words, the people who practice the power in society and the people who are othered and excluded from the mainstream. I clearly see injustice is often being done in many areas of our society, marginalizing certain groups of people, such as women, minorities, and working class people. One may say that my research is politically inclined. I cannot and will not deny that my research has a political aspect as well as the institutional aspect as professional educational research. I accept the argument, made by many qualitative researchers, that every single study has social, political, and ethical dimensions and that keeping silence is also tremendously political because it implies congruence or obedience to the established social order and culture. In the same manner, I am also aware of the political implications of so-called "academic research" and the very existence of "academics" itself in society.

One of my primary concerns in this study is closely related to validity issues about qualitative research in general. I have clearly expressed my perspective, including the theoretical framework and lenses that I am going to use for this investigation. Therefore, there is a possibility that the entire process of this study will be influenced by my subjective point of view. My prejudgments and prejudices may prevent me from reaching a deep understanding of the phenomena under investigation. To prevent many possible errors and shortfalls, I have set some research strategies to help me be more reflective on and critical of my own research process so that the quality of the study can be maintained.

The first strategy is to display my subjectivity from the beginning of this study. I believe that it helps me to be aware of my biases and prejudices that are in effect when I look at the investigated phenomena through my participants' accounts. Another strategy that I used for the quality assurance of this study was triangulation of methods. I collected various types of data using different data collection methods and constantly contrasted and compared each segment of the data with the others. I believe that this process helped me to find the most consistent and relevant understanding of the phenomenon. I also continuously searched for variations of understanding and interpretation of participants' voices. In this process, I situated participants' voices on different theoretical frameworks until I found the most persuasive and coherent explanation for the phenomenon.

In addition, I shared my data and the ways of analyzing and interpreting the data with my committee members and other colleagues so that they could provide me with insightful feedback from different perspectives. I believe this helped me reach the most objective and persuasive interpretation of the data possible.

Another important concern of mine for this study is related to my relationship with participants. Recently, many qualitative researchers have questioned and criticized the conventional mode of relationship between researchers and participants (Tierney, 1994). In traditional research, the researcher exclusively practices power to control over his or her

participants as well as the data generated from the participants: the researcher not only controls the direction and flow of the research but also interprets the data heavily based on his or her point of view. Breaking up the conventional mode of a researcher's relationship with participants is one of the most demanding tasks to many qualitative researchers.

Many qualitative researchers often prefer to use the term of "co-researcher" instead of "subjects" or "participants." They invite their co-researchers to participate in nearly the entire process of their study, including the data analysis process. In this study, I was not able to invite my participants as co-researchers. The primary reason was the limit of time available to the majority of my participants, seven students. Even though the participating students eagerly reviewed their own interview transcripts and provided me with their feedback I noticed that the majority of them had little time to do more than that. Some parents also limited my interactions with their daughters only within the school setting, which left me having a very limited time with the participants. In fact, time constraint was not the only problem, but just one of many. The motivation level of some participants in this study fluctuated throughout the semester and I had to pay close attention to what they were willing to do with excitement, and what they considered as an extra boring work. Cultural and language-related barriers continually emerged as main challenges in my research process because my inquiry was primarily based on the use of a language that is not my first language. Besides, I was brought up in a very different cultural setting from that of my participants. Therefore, the possibility of misunderstanding and misinterpretation of their spoken words is not trivial.

Recognizing my subjectivity and its possible influences on my interview process, I was very well aware of the fact that my interview process itself was dialogical, containing various voices including the participant's voice and my voice as primary voices. At the same time, I tried to situate the participants' voices in a concrete sociocultural context, not confining the voices in their individual minds. For example, I tried to connect their voices with various social and cultural ideologies, which they breathed everyday in the real world, so that the social dimension of their

voices, their minds, can be revealed. Also, by admitting the fact that there was more than one voice and one meaning in participants' spoken words, I tried to discover multiple layers of voice and meaning.

When I think about the validity of my research, I often look into how my research might influence the direction of the academic discourse in mathematics education. I often think about how professional and ordinary readers will read the findings from my study, and what kind of implications the readers will acquire from my research report. The social meaning of my own research, as defined in a concrete social context, is one of my important concerns. For this reason, I am trying to closely monitor my way of doing research in order to assure that my research really serves my declared research purposes. Not all of the answers are optimistic or positive, but I know it is a process that I have to go through as an educational researcher. There are always possibilities that I might stray in my research processes. The only thing I can do is simply open the door for outside challenges and encourage my critical subjectivity to become even more critical, especially of my own points of view.

CHAPTER 2

THEORETICAL FRAMEWORK

Gender issues in mathematics education can be explored from various perspectives. During the last few decades, different perspectives and theories have been introduced into the research literature, enriching the discourse on gender issues in mathematics education. In this study, at least three different streams of theories have significantly contributed to the researcher's understanding of gender issues in mathematics education: critical theories, feminist theories, and constructivism, including social constructivism. In the following section, I will describe briefly the three theoretical frameworks as well as their implications for gender issues and motivation in mathematics education. Social constructivism, as advocated by the Bakhtinian circle, will be explained in more detail than the other theories because it not only informs the study by offering a theoretical framework, but also provides important implications for the research process by emphasizing the dialogical nature of research.

Critical Theories

Critical theory examines the current structure of society, in which dominant socioeconomic groups exploit and oppress subordinate groups such as ethnic minorities, working class people, and women (DeMarrais & LeCompte, 1998). Critical theorists believe that certain groups in any society are privileged over others, constituting an oppression that is most forceful when subordinates accept their social status as natural, necessary, and inevitable (Kincheloe & McLaren, 1994). Yet, critical theorists maintain hope for transformation of society despite the influence of oppressive reproductive forces existing in society. They refer to people's active participation in reality as human agency and believe this is the main force to resist the current social injustice and help society move forward.

Critical theorists argue that schools, as a public sphere, are sites where power struggles between dominant and subordinate groups take place. They are interested in analyses of how schools are structured and function to help dominant groups maintain their position of power, as well as how subordinate groups resist this domination. On the macrostructure level, critical theorists view schools as places where a class-based society is reproduced through the use of the economic, cultural, and hegemonic capital of the dominant social class (Bourdieu & Passeron, 1990). On the micro-level, critical theorists view schools and classrooms as sites of cultural production, where people interact to construct meaning.

Critical theorists differentiate themselves from traditional Marxists or correspondent theorists such as Bowles and Gintis (1976) who emphasize the seamless reproduction process of the current status quo through schooling. To the contrary, critical theorists focus on the concept of agency as well as schools as a public sphere, where different groups of people participate in political discourse. They argue that those involved in the schooling process, such as teachers, administrators, and students, are able to resist the oppressive practices of schooling by developing their critical consciousness. In this case, schools are not merely places for cultural and economic reproduction for the status quo, but can become sites of social change.

Some educational ethnographers, called critical ethnographers (Anderson, 1989; Bennett, 1991; Gitlin, Siegel, & Boru, 1989) have approached schools based on critical perspectives. They have adopted ethnographic research methods of anthropology and qualitative sociology as traditional anthropologists do. However, critical ethnographers assume or explicitly state that schools contain both empowered and disempowered groups of people, and that there are constant power struggles among those groups. Some researchers subscribing to critical perspectives even advocate abandoning scholarly detachment for active confrontation with oppressive situations and individuals (Fine, 1994).

Critical theorists believe that sociocultural power is maintained through the control of the type and flow of information and that dominant groups use the curriculum, methods of

instruction, and modes of evaluation to maintain social inequities. They investigate the curriculum in an attempt to determine how hierarchically arranged bodies of knowledge help stratify children to receive differential learning through the practices of ability grouping and academic tracks (Oakes, 1990, 1992). They argue that the current educational structures and practices marginalize or disqualify certain groups of people, such as women, minorities, and members of low socioeconomic classes from positions of influence in society (Apple, 1988). In particular, critical ethnographers research micro-level human interactions in schools or classrooms to understand how subordinate groups confirm or resist dominant structures and practices (Spindler, 1996). By uncovering the ways in which school structures disempower groups, critical theorists, including critical ethnographers, hope to be able to propose transformative approaches to education.

Even though critical theorists have often been criticized for not paying enough attention to women's issues in education (Weiler, 1988), critical theorists' perspectives have greatly contributed to researchers' understanding of gender inequity phenomena in mathematics education. Researchers, subscribing to a socially critical perspective in their studies on gender and mathematics, have often argued that mathematical knowledge and its instructional practices reflect the male-centered cultural values, resulting in social inequality between men and women (Willis, 1996). In fact, recent calls for research that connects class issues and gender issues reflect the influences of critical theory in mathematics education (Abreu, 2000; Atweh et al., 1998; White, 2000).

Feminist Theories

Feminism is both a theory of women's position in society and a political statement focused on gaining equal rights and opportunities for women and changing power relations between men and women (deMarrais & LeCompte, 1998). Even though many feminists have divergent opinions about the causes and solutions of the alleged inequity between men and women, they do share some common points of view. Feminists, regardless of the differences among them, devote

themselves to explaining and transforming societal institutions and practices that have systematically oppressed and alienated women in our society.

In the area of education, feminists focus on how school curriculum and practices contribute to the unequal distribution of power between men and women. Early feminist scholars were deeply influenced by traditional Marxist analysis and have been primarily concerned with social reproduction (Weiler, 1988). Their studies, mostly based on document analysis and quantitative data, focused on the ways school systems consistently marginalized women culturally and economically (Deem, 1978; Wolpe, 1981). Another group of feminists paid more attention to the aspect of resistance by girls to the patriarchal schooling system (Arnot, 1982, 1984; Kelly & Nihlen, 1982). For example, Kelly and Nihlen (1982) found that girls did not accept the ideological message of the school unproblematically but rather negotiated with such influences based on their own emotional, intellectual, and material needs. Realizing that there are at least two contradictory cultural processes, reproduction processes and resistance, simultaneously existing in schools, Arnot (1982) proposed a theoretical framework weighing the complexity and dynamics of schooling processes. She introduced the term of "hegemony" into feminist analyses of schooling to emphasize the dialectical relations among various forces in and out of schools:

> By putting the concept of hegemony, rather than "reproduction" at the fore of analysis of class and gender, it is less easy in research to forget the *active* nature of the learning process, the existence of dialectical relations, power struggles, and points of conflict, the range of alternative practices which may exist inside, or exist outside and be brought into the school. (p. 66)

There is another group of feminist scholars who are interested in women's unique ways of self-development and academic learning. Gilligan (1993) elucidated different courses of moral development for men and women, identifying women's unique ways of constructing their relational world based on different ethics and principles from those of male-dominated society. She criticizes the predominance of men's voices in western psychology, which do not recognize

women's different interpretations of the world and often devalue their ethical standpoint as inferior or immature. In the same vein, Brown and Gilligan (1992) made a great contribution to understanding of the ways girls are socialized from childhood through adolescence. In their book, *Meeting at the Crossroads: Women's Psychology and Girls' Development*, Brown and Gilligan (1992) explored the lives of young girls through extensive interviews, documenting a silencing of their voices as they move through adolescence. The researchers found that as young girls begin to understand the relational cost of expressing their real thoughts and feelings, they start silencing themselves and behaving in ways considered more appropriate for "good little girls." They often hide their thoughts or feelings so as to avoid hurting people or risking relationships.

> For girls at adolescence to say what they are feeling and thinking often means, in the words of many girls, to risk losing their relationships and finding themselves powerless and all alone. Over the years of our study, even as they became more sophisticated cognitively and emotionally, young girls who had been outspoken and courageous in both an ordinary and a heroic sense, became increasingly reluctant to say what they were feeling and thinking, or to speak from their own experience about what they knew. (Brown & Gilligan, 1992, p. 217)

The phenomenon of "girls' loss of voices" has also been found in many other studies. Researchers argue that girls' silence reflects the distorted development of their academic and personal identities, and the inner conflicts that they experience in male-dominating society. For example, Rogers (1993), in her study with several young adolescent girls, reported the loss of voice among her participants, which reflected their shaky identity in men's world. Harter, Waters, and Whitesell (1997) argue that young adolescent girls' loss of voice in a school setting reflects their false self-manifestation. They found that young adolescent girls' social interactions in their classrooms decreased as the girls grew older. The researchers argue that girls, who become increasingly aware of social expectations and pressure, gradually develop and manifest false self-identities by silencing themselves.

Many researchers from feminist perspectives have adopted the concept of voice as a critical aspect of one's identity formation. To them, voice is not a mere vocal sound through which we communicate with each other. They interpret that voice has much more meaning and weight in our lives. For example, Belenky and her colleagues (1986) argued that having or speaking one's own voice has inexorable existential and epistemological meaning. In *Women's Way of Knowing,* they argued that voice is more than "an academic shorthand for a person's point of view" (p. 18). Here, voice is a metaphor that represents much of the lives and experiences of women, including the ways of forming self, personality, and identity as well as ways of knowing.

Erchick (1996) argues that in mathematics classrooms many who feel unheard, who recognize a dis-synchronicity between their voice and the dominant voice, find no place for themselves. She contends that many adolescent girls may fail to develop a positive academic identity in mathematics because the culture of the mathematics class, as reflecting mathematics as men's domain, discourages them to make their own voice, therefore depriving them of a way to develop their own mathematical identity (Erchick, 2001).

Concepts from feminist theories and premises of voice, as described above, share some similarities with those of social constructivism. Both emphasize the critical role of voice as the way of forming one's identity. They also agree that voice plays an important role in establishing equal rights for dominated people, including minorities, women, and working class people in our society (Belenky et. al., 1986; Oldfather, 1992, 1993; Oldfather & McLaughlin, 1993).

Social Constructivism

It is generally acknowledged that constructivism is one of the most important practical and theoretical perspectives in current educational research. Generally, there are at least three different theoretical perspectives under the huge umbrella term of constructivism: cognitive constructivism, radical constructivism, and social constructivism (Cobb, 1996; Fosnot, 1996; von Glasersfeld, 1995). Cognitive constructivism, represented by Piaget's cognitive developmental theory, explains that knowledge is actively constructed by the learner and not passively

transmitted by the educator (Fosnot, 1996). Radical constructivism, advocated by von Glasersfeld and others, views human cognition as an adaptive process which is primarily based on, and constantly modified by, a learner's experience (von Glasersfeld, 1990, 1995). Social constructivism, sociocultural approaches, is derived from the work of Vygotsky and Bakhtin, two important scholars in cultural psychology, who stressed the primary role of communication and social life in meaning formation and cognition (Cobb, 1996; Nuthall, 1996; Prawat, 1996; Wertsch, 1991).

Sociocultural Approaches to Mind

Sociocultural approaches to the mind, as founded in Vygotsky and Bakhtin's works, begin with the assumption that "action is mediated and that it cannot be separated from the milieu in which it is carried out (Wertsch, 1991, p. 18)." The approaches emphasize the importance of the sociocultural, as well as the historical, environment in the formation of an individual's mind. Luria (1981) argues that one must go beyond the human organism in order to explain the highly complex forms of human consciousness: the origins of human consciousness activity and categorical behavior are "not in the recess of the human brain or in the depths of the spirit, but in the external conditions of social life" (p. 25). The external processes of social life, in the social and historical forms of human existence, are viewed as the main force that shapes the human consciousness.

One interesting aspect of Bakhtin's theory is the concept of "self." For members of Bakhtin's circle, an individual consciousness, his or her subjectivity, is not a self-sufficient, pre-constituted entity, but is formed through the dialogic struggle between contending voices or discourses. Bakhtin's entire work, including the conception of self, is based on criticism of individualism and dualism that were prevalent in western society during his era. He continually stresses that all social and cultural phenomena are profoundly intersubjective or dialogic in nature, and that the formation of self is not an exception either. Clarke and Holquist (1984) explain "the Bakhtinian self is never whole, since it can only exist dialogically. It is not a

substance or essence in its own right but exists in a tensile relationship with all that is other and most importantly, with other selves (p. 65)." Human subjectivity is born through the continuous dialogue with the "other," with oneself (inner speech), and with the external world and this dialogic process is constitutive of any possible creative thought or deed.

Even though Bakhtin and his colleagues explain the subject as an internally complex and socially constituted entity they do not fully subscribe to all aspects of the poststructuralist decentering of the subject. They, specifically Voloshinov, argue that the subject does have a biographical and biological unity, which is derived from both the nature of the biological organism and the relevant socio-historical conditions (Bakhtin, Medvedev, & Voloshinov,1994; Vice, 1997; Wertsch, 1991). Bakhtin's circle seems to acknowledge something called "human nature," which is not a fixed or static essence but a historically constructed and socially embedded complex of qualities, capacities, and power. Therefore, it is fair to say that Bakhtin and his colleagues retain a conviction in the efficacy of human agency while acknowledging the structural constraints of existing social institutions, ideological formations, speech genres and so on.

Therefore, "self" for Bakhtin is not constituted through a unified, monadic relation to the external world. Rather, the phenomenon of "self-ness" is constructed through the operation of a dense and conflicting network of discourses, cultural and social practices and institutional structures, which are bound up with the intricate phenomenology of the self-other relation.

Voices of Possibility and Resistance

One of the most important contributions made by social constructivists is that their theory enables educational researchers to see the multiple sociopolitical layers embedded in a person's speech and identity: there is more than one voice and one identity in an individual's spoken word. Bakhtin (1981) states:

> As a living, socio-ideological concrete thing, language, for the individual consciousness, lies on the borderline between oneself and the other. The word in

> language is half someone else's. It becomes “one's own” only when the speaker populates it with his own intention, his own accent, when he appropriates the word, adapting it to his own semantic and expressive intention. Prior to this moment of appropriation, the word does not exist in a neutral and impersonal language, but rather it exists in other people's mouths, in other people's contexts, serving other people's intentions: it is from there that one must take the word, and make it one's own. And not all words for just everyone submit equally easily to this appropriation, to this seizure and transformation into private property: Many words stubbornly resist, others remain alien, sound foreign in the mouth of the one who appropriates them and who now speaks them; they cannot be assimilated into his context and fall out of it; it is as if they put themselves in quotation marks against the will of the speaker. Language is not a neutral medium that passes freely and easily into the private property of the speaker's intentions; it is populated -- overpopulated -- with the intentions of others. Expropriating it, forcing it to submit to one's own intentions and accents, is a difficult and complicated process. (p. 114)

Acknowledging the sociopolitical nature of language, the incessant tensions and dynamics among different intentions and powers deep-seated in it, Bakhtin believes that subordinate groups can generate a differentiated not yet complete set of knowledge, which is embedded in traditions and practices, and which is, at least, partially resistant to dominant discourses and ideologies (Vice, 1997; Wertsch, 1991). Influenced by Bakhtin's idea of language as a discursive practice of social life, some feminist theorists and critical theorists have developed the concept of “language (voice) of possibility” (Giroux, 1991, p. 53) and “language (voice) of resistance” (Bauer & McKinstry, 1991, p. 4). They view discursive practices through language as the way of dismantling the oppressive social reality in which people are situated.

CHAPTER 3

LITERATURE REVIEW

Many educational researchers have investigated gender differences in mathematics during the last few decades, accumulating a great amount of literature from various theoretical perspectives. Therefore, it is not easy to summarize all of the previous studies that addressed gender and motivational issues in mathematics education. For this reason, I will, in this literature review section, describe briefly some previous studies that will best support my study, showing the complexity of gender issues in mathematics education. This section consists of three subsections addressing different groups of motivation research dealing with gender issues in mathematics education: traditional motivation research on gender differences in mathematics, sociocultural approaches on students' motivation, and recent qualitative research on motivation.

Motivation and Gender Differences in Mathematics

Young Adolescent Girls and Mathematics

Early adolescence is a critical time in which students develop their academic self-concepts in various academic domains including mathematics. Research suggests that individuals' academic self-concepts and their values attached to a certain subject are some of the most critical predictors of their actual success and future choice to take advanced courses in the disciplinary area (Eccles et al., 1983; Fennema & Sherman, 1978; Leder, 1992; Meece, Wigfield, & Eccles, 1990). Unfortunately, the current situation in which female students find themselves is not favorable for the development of their positive academic self-concept in mathematics. Though not measured consistently until high school gender differences in mathematics favoring boys are most often found in students' performance on standardized achievement tests and tend to be strongest among the top-performing students. (Ansell & Doerr, 2000; Beaton et al., 1996;

Crosswhite et al.,1986; Hedges & Nowell, 1995; Meyer, 1989; Mullis et al., 1994; Rock & Pollack, 1995). Even though this kind of gender difference in mathematics achievement has been gradually decreasing, the inequity between girls and boys in school mathematics education is still persistent (Fennema, 1990, Fennema & Hart, 1994; Hanna, Kundiger, & Larouche, 1990).

Many studies on student motivation reported that female students in middle and high schools express lower self-confidence in mathematics than male students and, as a result, are more likely to avoid taking advanced math courses in high school (Eccles et al., 1983; Meece et al., 1990). Several researchers (Bruner, 1996; Marlow & Marlow, 1996) have investigated girls' experiences in mathematics during adolescence, which is known as the time when many young girls begin to turn away from mathematics (Dick & Rallis, 1991; Sadker & Sadker, 1994).

A national report that examined gender differences in mathematics achievement (National Research Council, 1989) reported that boys and girls progress through the mathematics curriculum showing little difference in ability, effort, or interest until the adolescent years. Then, as social pressures increase, girls tend to exert less effort in studying mathematics, which progressively limits their future education and eventually their career choices. This report also noted that gender differences in mathematics performance result from the accumulated effects of gender-role stereotyping perpetrated by families, schools, and society (Manning, 1998).

To explain gender differences in mathematics achievement, researchers have referred to various social and cultural factors that influence female students' mathematics learning experiences. They argued that various sociocultural factors play crucial roles in shaping students' motivation toward and beliefs about mathematics learning, resulting in different choices and unequal achievement levels among different groups of students, including female students (Reyes & Stanic, 1988). Based on existing literature, researchers often expressed a need for studies examining the nature of adolescent girls' experiences in mathematics in order to illuminate the reasons and processes of the girls' later decision making in the domain (Marlow & Marlow, 1996).

Traditional Motivation Research in Mathematics Education

Research on student motivation has a long history in education. Many researchers in educational psychology have investigated student motivation, focusing on the interrelationships among various motivational constructs within an individual as well as their relationships with actual academic performance. Wigfield and Eccles are among those researchers who have focused their investigation specifically on students' motivation in the mathematics domain. They have argued that students' perceptions of ability and expectancy for success are stronger predictors of their subsequent grades in mathematics than either previous grades or achievement values (Wigfield, 1994; Wigfield & Eccles, 1992). Their studies also showed that students' achievement values, such as liking of tasks, importance attached to them, and their usefulness, are the strongest predictors of students' intention to continue taking advanced math courses in the future and actual decisions to do so. These studies used specific instruments to assess various motivational constructs of individual learners. Their sample sizes were usually quite large.

Realizing that students' confidence level is positively and strongly correlated with mathematics achievement, researchers investigated several other factors that may influence students' beliefs and confidence levels. They found that students' confidence level is related to patterns of classroom interaction between students and teachers, ultimately influencing their elective enrollment in mathematics courses (Fennema, 1989; Hart, 1989; Linn & Hyde, 1989; Reyes, 1984). These studies were based on two types of methodologies: classroom observation and other quantitative data. Their classroom observation was rather focused, using a predetermined set of checklists for observation. Their research often included other types of statistical data from schools and researchers' own assessments of participating students. Among the quantitative data are student mathematics achievement, confidence level as used in Eccles and her colleagues' studies, and students' enrollment in elective or optional mathematics courses.

Educational researchers not only found that students' achievement in mathematics is closely related to their confidence level and perceived value of the mathematical tasks, but also

reported significant differences in some motivational constructs between boys and girls. Wigfield and Eccles (1992) developed the Academic Choice Model to explain students' mathematics achievement in relation to various motivational constructs, such as students' expectancy and the value of learning mathematics. The Academic Choice Model is a kind of path analysis model explaining the interrelationships of various motivational constructs and other factors, such as family factors or school factors, as well as the strength of each relationship. Several studies based on this model confirmed differences in various motivational constructs between boys and girls (Eccles [Parsons], 1984; Eccles, et. al, 1983; Meece et al., 1990). For example, Meece et al.'s study (1990) found gender differences, favoring boys, in students' expectations for success, ability perceptions, and intentions to take more advanced mathematics courses in the future. Girls reported higher levels of mathematics anxiety than did boys in this study.

Ethington (1991) adopted the same model to examine course enrollment intentions among eighth grade students. She again found that girls had lower perceptions of their mathematics abilities than boys. Girls also perceived mathematics as more difficult than boys. She found that students' enrollment intentions were most directly related to expectancy and value perceptions. Yet, she reported that the strengths of these relationships were different for boys and girls. For boys, both expectancies and values had the strongest direct impact on course enrollment intentions. However, in the female sample, values and career goals emerged as the strongest predictors of course enrollment plans. This indicates that girls who viewed mathematics as useful and planned to have a job using mathematics intended to take optional mathematics courses. Socialization influences on academic achievement perceptions also differed between boys and girls. For both boys and girls, self-concept of mathematics ability and perceived difficulty of mathematics influenced their expectations for success in mathematics, but career goals and the extent of family help had an additional influence on the girls' expectancy perceptions. This study also showed that prior achievement did not predict boys' and girls' expectancies in mathematics, but it did predict the value they attached to mathematics.

Based on her previous studies, Ethington (1992) suggested different motivational construct models for boys and girls' mathematics achievement. In these models, male students have only two variables, prior achievement and value, that significantly influence their current mathematics achievement. Three other variables, beside the two variables identified above, also have significant direct effects on achievement for female students: family help, stereotyping, and perception of difficulties.

Critiques of Traditional Motivational Research

While the majority of educational psychologists and mathematics educators investigated the motivational constructs of individual learners to explain gender differences in mathematics performance, other researchers, mainly from different theoretical or disciplinary backgrounds, suggested other frameworks for the same issue (Apple & Weis, 1986; Baker & Jones, 1993). They believed that psychological approaches had a serious limitation in explaining gender inequity in mathematics because they overlooked the complicated and dynamic sociocultural impacts on individuals' motivation and learning behaviors. Apple (1988) stated that mainstream educational research has been dominated by individual-focused psychological approaches, failing to examine the overall societal impacts on students' motivation and academic achievement. Apple and Weis (1986) argue:

> This has been recognized for years by many people who work in schools and/or write about them, the mainstream of educational research, unfortunately, has been overly psychological. By focusing primarily on how to get students to learn more mathematics, science, history, and so forth (surely not an unimportant problem), it has neglected to inquire into the larger context in which schools exist, a context that may actually make it very difficult for them to succeed. (p. 7)

This kind of criticism of motivational research based on a psychological model has gained considerable support from many educational researchers, including those in mathematics education. Researchers began to reshape their questions about students' motivation in

consideration of various sociocultural factors within a specific context. It is now widely accepted that the relationships among motivational constructs, and actual mathematics achievement are always influenced, or mediated, by various sociocultural factors (Uttal, 1996). Some researchers even view learning itself as a socially constructed process, not as a pure psychological process of an individual (Abreu, 2000; Cobb, 1996; Lave, 1981). From this point, mathematics knowledge and learning mathematics are understood as socially constructed processes that are situated in a specific sociocultural context.

Recently, studies on these sociocultural influences have begun to receive an increased attention in mathematics education, particularly because of their relationship to issues of gender and ethnicity. Reyes and Stanic (1988) suggested a theoretical framework that explains group differences in mathematics achievement. This model posits the relationships among several groups of variables, including societal influences, school mathematics curricula, teacher attitudes, student attitudes and achievement-related behaviors, classroom processes, and student achievement. The model begins with societal influences outside of school that may send different messages to and about students of varying race, gender, and SES regarding their aptitudes and the appropriateness of their achieving at a high level in mathematics. Examples of societal influences are the family, community, and country in which the student lives, in addition to the mass media, and the implicit messages that result from the pattern of prevailing occupational and other societal roles held by members of particular groups. In the model, societal influences are posited to have a direct effect on student attitudes, including students' motivation and judgment of the value of mathematics and appropriateness of learning mathematics.

Sociocultural Approaches

Recognizing the importance of sociocultural influences on student motivation and gender differences in mathematics, different groups of researchers conducted research that illuminates the relationship between students' motivation or achievement in mathematics and the larger sociocultural context (Becker, 1981; Baker & Jones, 1993; Jacobs, 1991; Jacobs & Eccles, 1985;

Leder, 1986; Muller, 1998; Tiedemann, 2000). They examined and identified different sociocultural factors in and out of schools as to contribute to gender differences in either students' motivation or achievement. Some researchers (Secada, 1992; Ladson-Billings; 1997; Tate, 1997) are more interested in the impact of ethnicity, race, and SES background of students in explaining students' motivation, asserting that gender inequity problems cannot be separated from those factors. Yet, others (e. g., Becker, 1981; Hart, 1989) focus more on classroom environment, arguing that classroom culture, including teachers' differential treatments for boys and girls, contributes to gender inequity in mathematics education.

Impact of Culture, Ethnicity, and SES

Many researchers have contributed to our understanding of sociocultural impact, such as students' culture, ethnicity, and SES backgrounds, on motivation. Uttal (1996) discussed the cultural influences, specifically familial influences, upon students' beliefs and actual performance in mathematics. His discussion was based on a series of studies conducted by a group of researchers including himself (Stevenson, Lee, & Stigler, 1986; Stevenson & Stigler, 1992; Uttal, Lummis, & Stevenson, 1988). These studies were cross-national studies between the United States and two Asian countries, China and Japan, and were based on a variety of information about students and their families, such as the mathematics achievement tests and detailed battery of intellectual ability tests, and interviews with children, their mothers, and their teachers. Uttal (1996) reported that American parents were more likely to believe that the mathematics achievement of their children depends on their innate mathematics ability rather than their effort, while Asian parents were more likely to think effort is more important for mathematics achievement. Not surprisingly, children's beliefs about their mathematics ability were consistent with those of their mothers.

Children's expectation of and satisfaction with their own mathematics performance were also consistent with those of their mothers. American parents' expectations for their children's mathematics achievement was lower than that of Asian mothers, and American parents were

more satisfied with their children's current mathematics achievement than are Asian mothers (Lee, Ichikawa, & Stevenson, 1987; Stevenson et al., 1990; Stevenson & Stigler, 1992). Uttal explained that Confucian ideology in these Asian countries, which emphasizes hard work and effort for self-improvement, might have influenced parents' overall attitudes toward their children's mathematics achievement. Uttal suggests that these kinds of cultural influences from families may be the factors that explain the relatively lower mathematics achievement of American students. He also cautiously interpreted that widespread genetic determinism about mathematics learning in the United States might be one of the factors that contribute to American parents' relatively lower expectations toward their children's mathematics achievement.

Markus and Kitayama (1994) have provided a more in-depth explanation about cultural influences on motivation. They argue that the culture of each society largely shapes motivations and attitudes of individuals within it. As an example, they refer to some Asian countries influenced by Confucianism, which have quite a different cultural framework from that in the United States. They explained that individuals in these Asian societies are more sensitive in responding to various social expectations from outside the individual, and are more willing to conform themselves, following the expectations. Therefore, it seems to be natural for most Asian students to try to meet their parents' expectations about their mathematical achievement.

This kind of cultural difference between the two sides of the Pacific Ocean can also be found within the United States. Many recent Asian immigrants, who are preserving their ethnic and cultural identities, are still under the influence of Confucianism regarding their children's education. They often show similar attitudes and value systems as the people in their original countries. Huang (1993, 1994) confirmed Uttal's findings from his own study with Asian American and Caucasian students. He used a similar survey instrument to Uttals', but conducted additional focus interviews with participants in order to complement the findings from survey data. He found that Asian American parents were more interested and involved in what their children were doing in mathematics than were White-American parents (Huang, 1993). Asian

students reported a higher expectancy than White students in mathematics achievement, and Asian students' expectancy was consistent with that of their parents. Huang also found that Asian American students reported greater pride in their classwork, a stronger desire to succeed, and higher expectations to do well in mathematics than Anglo-American students. He suggested, like Uttal, that family culture, including parents' expectations for their children's mathematics achievement and the values attached to mathematics, significantly influence children's motivations for and actual performance in mathematics.

Researchers investigating gender issues in mathematics education also found similar kinds of familial influences on students' gender stereotyped beliefs (Jacobs, 1991; Tiedemann, 2000). Tiedemann (2000) found that parents' stereotyped beliefs about mathematics influence their children's perceptions about their own mathematical ability. He administered a survey instrument that incorporated a psychological measure of individuals' stereotyped beliefs about mathematics. In this study, German parents often showed a stereotyped thought about their children's mathematics ability. Tiedemann reported that the pattern of parents' influence upon their children's perceptions of their own mathematical competence was similar to that found in the United States. The German parents who held stereotypical views on gender often assigned greater ability in mathematics to their sons than their daughters. Moreover, parental stereotyping seemed to influence their children's self-perception of their mathematical ability as early as the middle elementary years, although it had no effect on elementary children's school performance.

O'Brien, Martinez Pons, and Kopala (1999) found that students' self-efficacy in mathematics was influenced not only by their academic achievement but also by their ethnic identity and socioeconomic status. Their study was primarily based on quantitative data generated from a few psychological measurements. In addition, they found that students' gender directly impacted their career interests which, in turn, were predicted by their self-efficacy in mathematics. They argue that students' career interests are influenced by gender-stereotypes in current society while

various sociocultural factors, such as ethnicity and SES, mediate students' self-efficacy in mathematics.

Sociopolitical Aspects of Mathematics Classrooms

Educational researchers have explored gender issues in mathematics education in relation with the sociopolitical aspect of the mathematics classroom. They believe that teachers' interactions with students and the mathematics classroom culture are influenced by various sociocultural factors within and outside of the school (Atweh et al., 2000; Leder, 1990; Reyes & Stanic, 1986). In fact, many studies reported that teachers' interactions with students differ based on the gender of the students (Koehler, 1990). Teachers gave more criticism, as well as praise, for correct answer, to male students. Male students' work was monitored more frequently and males had more contacts with their teachers than female students (Becker, 1981). Teachers tended to stereotype mathematics as a male domain; this was reflected in teachers' tendencies to overrate male students' mathematics capability, have higher expectations for male students, and have more positive attitudes about male students (Jungwirth, 1991; Li, 1999; Tiedemann, 2000). The majority of studies in this category used observation as a primary research method, specifically classroom observation with detailed and pre-determined checklists for teachers' and students' behaviors.

One of the representative studies in this category is Hart's study (1989) with middle school mathematics classrooms. She reported a difference in teacher-student interaction in mathematics classes. She divided interaction types into two categories, public interactions and private interactions. Public teacher-student interactions were interactions between the teacher and an individual student that occurred when the attention of the class was on the interaction and on the teacher. In private teacher-student interactions, the attention of the class was not on the interaction. The researcher found that students' gender was a more important determinant of student-teacher interaction in public than was the confidence level of the student. Based on the results from the studies above, researchers argue that teachers' stereotyped perceptions about and

gender-based interaction with their students are important factors in the examination of gender-related differences in attitudes towards mathematics (Armstrong, 1982; Boswell, 1985; Brush, 1985; Koehler, 1990).

Atweh et al. (1998) illuminated the complexities and dynamics of mathematics classrooms in relation with students' gender and SES backgrounds. In this study, they focused on the effects of two factors, student socio-economic background and gender on teachers' perceptions of students' needs and abilities. Atweh et al. also examined how the teachers' perceptions shaped the discourse in the classroom. Their analysis is based on data from long-term classroom observations and open-ended in-depth interviews with participating teachers. They found that teachers were aware of the effects of teacher-student interactions in relation to their students' gender and socioeconomic backgrounds. Classroom interactions were consistent with teachers' perceptions about students' abilities and needs, and this tended to have a self-fulfilling role for teachers' expectations. Atweh and his colleagues concluded that the mathematics teachers intentionally modified their teaching behaviors based on their expectations and perceived ability of students, which were, in turn, primarily based on student gender and SES.

On the other hand, mathematics education researchers found specific cultural aspects of mathematics classrooms encouraged or discouraged girls' participation in mathematical activities and their development in mathematical understanding. Male students preferred active games and pastimes that focused on skills and mastery of objects while females preferred play that was concerned with interpersonal relationships (Fennema & Peterson, 1987; Leder, 1986). Adedayo's study (1999) supported the previous findings by showing that use of interactive methods with group use of materials favored males while interactive methods with individual use of materials favored females.

Smart (1996) also found that female students became more effective learners when they were learning mathematics in a caring classroom environment. Based on Her Majesty's Inspectorate (HMI) documents, she reported that girls succeeded in mathematics when teaching

was sensitive and perceptive. She explains that a competitive and threatening atmosphere in the mathematics classroom is one of the greatest obstacles to many female students learning mathematics. Therefore, she suggests that providing girls with opportunities of learning mathematics in congenial and appropriate conditions will help them reach their potentials as learners. Boaler's study (1997) also reported a similar finding that girls prefer a project-based mathematics curriculum, in which students' voluntary participation and cooperative group work are encouraged, rather than competitive and procedural approaches to teaching and learning mathematics.

Recently, researchers have expanded their analysis of sociopolitical aspects of mathematics learning beyond classroom interactions and culture. They not only have investigated the inequity in teacher-student interactions in the classroom but also have problematized the nature of mathematical knowledge and inquiry as being biased (Abreu, 2000; Ernest, 1995; McBride, 1989). They began to analyze mathematics classrooms in a larger sociocultural context so that they can find how the power relationship between legitimate mathematics constructed in the western intellectual tradition, and other types of mathematical knowledge are interrelated with larger social, cultural, and political issues in society (Abreu, 2000; McBride, 1989; Noddings, 1993). For example, McBride argues that mathematical knowledge itself, including textbook organization, teaching methods, examination system, mathematics rules, and social role of mathematical knowledge, reflects the culture of masculinity, excluding other ways of approaching and reconceptualizing mathematics. Her argument, in this study, is primarily based on hermeneutic induction or hermeneutic analysis of mathematical knowledge. She suggests that certain groups of students are forced to fail in the domain because mathematical knowledge itself has been constructed and delivered in a way that fails those students.

Abreu (2000) also acknowledges that a specific way of doing mathematics has been empowered over the others not only because of its effectiveness in solving practical problems, but also because it distributes unequal power to different groups of people. Abreu's argument is

originally derived from her previous ethnographic studies in a Brazilian rural school, which were based on long-term observation and informal interviews with children and teachers in the specific cultural setting. She emphasizes that various types of mathematical knowledge are attached to, and even identified with, a specific social class, reflecting the unequal political relationship among different social classes in society. She believes that the unequal power relationship among various types of mathematical knowledge reflects the very power structure of society.

Contributions from Educational Ethnography and Qualitative Research

Educational ethnographers and qualitative researchers have long argued that understanding the sociocultural context of learning is important in order to explain students' motivation and their learning behaviors in schools. They believe that the specific sociocultural context in which learning takes place actually supports or fails to support students' motivation to learn (Lave & Wenger, 1991; Spindler, 1996; Oldfather, 1993). These researchers have examined sociocultural differences among various ethnic and SES groups as well as the consequences of such differences on students' learning experiences. Influenced by this kind of work from their colleagues in the areas of educational anthropology and educational ethnography, mathematics education researchers have refreshed their perspectives on gender issues and students' motivation.

Educational Ethnography

A group of anthropologists have investigated the ways in which socioeconomic backgrounds of students, as often compounded with student ethnicity, influence their motivation for learning mathematics. Researchers argued that some groups of minority students from lower socioeconomic backgrounds often lack structural or extrinsic rationales for participating in school (D'Amato, 1988; Oakes, 1990; 1992; Spindler, 1996). They explain that most middle class children and their families understand that school success will bring real-life rewards in the form of good jobs and high salaries. To the contrary, many poor minority children have little real-life experience to support such beliefs and expectations because they may know few adults who have earned economic gain through scholastic achievement.

Several researchers have explored the sociopolitical aspects of school, class structures, and instructional practices which largely shape student motivation (Ames, 1992; Harter et al., 1997; Oldfather, 1993; Oldfather & Dahl, 1994; Rodgers, 1990). Oakes's studies on the school tracking system were some of those studies. Oakes (1990) argued that the tracking system in mathematics was a critical "filter," which actually prevented students from lower socioeconomic backgrounds from learning advanced mathematical knowledge. Oakes, Gamoran, and Page (1991) found that students in higher tracks tended to be more enthusiastic, while students in lower tracks tended to be more alienated. Students in lower tracks also reported less self-confidence about their academic capabilities compared to students in higher tracks. Oakes (1992) also found that curriculum tracking had a negative effect on students' attitudes toward school and themselves as learners, as well as their motivation to learn. She suggests that tracking practices in many schools may actually limit the access to mathematical knowledge of minority students, specifically African American and Hispanic students from lower socioeconomic backgrounds.

Ames (1992) elaborated on the concept of "belongingness" as an influential factor for students' motivation. She explains "belongingness" as the students' sense that "I belong here," and this kind of feeling helps students identify themselves with a specific subject as well as the purpose of schooling in general.

Qualitative Research on Motivation

Some researchers in the motivational research circle have been more interested in exploring the inner world of students' motivation, adopting qualitative methodology. They closely investigated students' motivation itself through observations and interviews. In her longitudinal qualitative study, Oldfather (1993) also emphasized the importance of students' situated perspectives about their own learning. She argued that students' intrinsic motivation is grounded on their sense of having *an honored voice*, a sense of self-determination, in their own learning process. Other educational researchers support Oldfather's argument, such as Duckworth (1987) who emphasized the importance of classroom environment to support students' own intellectual

pursuits. Wood, Bruner, and Ross' study (1976) also confirms Oldfather's and Duckworth's findings by reporting the importance of social support from peer interaction in students' learning process.

Oldfather's motivational research was influenced by social constructivists' point of view about knowledge, as well as education, which is very different from the traditional psychological perspective prevalent for many decades in the educational arena. Social constructivists argue that knowledge is a social construct of meaning in a specific sociocultural context (Oldfather & Dahl, 1994; Prawat, 1996). They believe learning is a social and collaborative activity that has a dynamic nature in the sociocultural environment. According to this perspective, school learning occurs in a sociocultural context and cannot be separated from children's learning developed in the "real world." Students' out-of-school experiences are closely related to their school experiences and learning processes.

Some motivation researchers, influenced by social constructivism, have redefined the concept of motivation in a more holistic way (Oldfather & Dahl, 1994). They acknowledge the constant tension and confluence of intrapersonal, interpersonal, and cultural aspects of the individual's learning and motivation. Social constructivists also believe that language is at the heart of all of these socialization and learning processes. Students' perspectives as insiders in classroom culture are crucial in providing clues to understanding these transactive motivational processes (Oldfather & Dahl, 1994; Oldfather & McLaughlin, 1993).

Oldfather (1992) proposed a redefinition of intrinsic motivation for literacy learning called the continuing impulse to learn (CIL). This concept is explicitly linked to learners' social construction of meaning. CIL, a form of motivation, originates in and is defined by, the cognitive, affective, and social processes that learners experience as they engage in meaning construction. She explains three aspects of CIL, classroom culture, interpersonal domain, and intrapersonal domain, which support or fail to support the individual learner's CIL. She argues that the quality of student-teacher relationships, students' perceptions of cognitive ownership of their own

learning process, and generative literacy curriculum in class are factors that support or fail to support students' CIL (Oldfather & Dahl, 1994).

Qualitative Studies on Girls' Motivation in Mathematics

Little research has investigated female students' mathematics learning experiences in order to elucidate their motivation constructs and societal impact on their motivation. However, a few studies have been conducted in the United Sates and other western countries such as Australia and in England.

Issacson (1990) conducted an interview study with female college students in order to illuminate their learning experiences in mathematics. She found that many themes that are now familiar in the gender and mathematics literature emerged from her data: the negative effects of learning mathematics in a competitive environment, some female students' fear and panic in mathematics lessons, and lack of support from teachers and parents. Yet, another important theme emerging from her study concerned the school organization, such as having optional or choice-based mathematics courses, and the expectations that schools conveyed to girls. In this study, Issacson describes the complexity of the process by which girls and women are, at times, alienated and excluded from mathematics.

Rodgers (1990) conducted a case study that examined female students' mathematics learning experiences in three Northern Ireland secondary schools. She adopted both quantitative and qualitative methodologies. A psychological instrument, assessing students' motivational constructs, was used along with in-depth interviews and ethnographic observation in the school for an extended period of time. Both boys and girls' intrinsic motivation in mathematics was related to their achievement as well as their values and attitudes toward mathematical knowledge. Teachers' encouragement and support were also identified as important factors that made students desire to learn more advanced mathematics. Rodgers also found that girls were more likely to attribute their success to hard work or luck rather than their abilities. Her findings from

qualitative data showed a consistency with findings in the previous literature on gender and mathematics.

Taylor (1990) conducted an interview study with twelve mathematicians in the United States. In this qualitative study, Taylor suggested that formation of an attitude towards mathematics is a complex process that involves the interaction of a number of factors and cannot be explained simply or completely. She specifically emphasized encouragement, love, and support from families who place a high value on education existed in her female participants' childhood.

Recently, Erchick (2001) investigated the process of young adolescent girls' losing voice in mathematics learning. She interviewed three female teachers who reflected on their own experiences in mathematics during their adolescent years. Erchick adopted Gilligan's notion of "voice," and applied it to female teachers' reflections on their own mathematical experiences in and out of schools. These women interpreted their mathematics learning experiences during adolescence as compliance with or resistance against social pressure, which urged them to give up their own mathematical voices. Erchick, in conclusion, suggested a program of mentoring in which adult women work with adolescent girls to support their development in mathematics.

Limits and Possibilities for Research on Gender and Motivation

Previous studies, regardless of their theoretical and methodological differences, have made a great contribution to our understanding of gender issues and motivation in mathematics education. Traditional psychological approaches revealed and confirmed significant gender differences in students' motivational constructs that seemed to cause a difference in their achievement and enrollment rate in advanced mathematics courses. Other researchers, interested in the sociocultural impact on students' motivation, as well as actual achievement, in mathematics, highlighted the critical roles of various sociocultural factors such as culture, ethnicity, and SES of students. In addition, they illuminated the importance of classroom culture, including teacher-student interactions, in supporting students' motivation in mathematics learning.

Educational anthropologists and qualitative researchers have also made a significant contribution to the educational research literature. They closely investigated the students' perceptions and experiences as well as the micro-level classroom processes in which students' motivation and academic identity are continually being reconstructed. They also linked the individual's perceptions and classroom processes with the sociocultural context in which the individual student and the classroom exist.

However, some fundamental problems plague most of the qualitative inquiries on gender and motivation research in mathematics. The most recent and well-informed studies also suffer from this limitation. First, there is still an unanswered question about how researchers connect sociocultural impact and female students' motivation or identity development in mathematics. How female students are influenced by various sociocultural factors is not explained except for the fact that there are correlations between students' motivation and sociocultural factors. The way in which researchers analyze the sociocultural impact on students' motivation is not clearly identified. Related to the first problem, the notion of self, as well as the notion of sociocultural environment, as defined by many qualitative researchers, seem to fall into dualistic thought. The notion of "self" should be revised in order to reflect its sociocultural aspect: the self is not only influenced by various sociocultural factors but it also has a sociocultural dimension within it. The third problem is the dilemma between the validity assertion of a qualitative study and its heavy reliance on subjective accounts of individual participants and hermeneutic interpretations of the researcher. Qualitative researchers have long struggled to more persuasively argue for the values of qualitative, hermeneutic understanding of social/cultural phenomena while not totally sacrificing the concerns for the objectivity and generalizability of academic research (Janesick, 2000). Responding to these three problems in research on gender and motivation, I suggest a new framework in which the topic may be more effectively approached.

I argue for two types of reconceptualizations, one is about the definitions of self and sociocultural environment, as well as their relationship; the other is about the nature of research using qualitative methods and in-depth interviews.

I believe that reconceptualization of self, based on Bakhtin's work, supports my inquiry into the nature of self, impact of various sociocultural factors, and their mutual dynamic relationship. Most previous motivational research has been based on individual psychology, assuming that there is a self-contained individual with a unified mind and homogenous voice. Not being far from this traditional thought, qualitative researchers have tried to reach "the pure essence of human experience" based on participants' interview data. Bakhtin's argument about "heterogeneity of one's voice" surely shows a way in which motivational researchers can reframe their perspective on student motivation in a fundamentally different way. One's voice, in its heterogeneity, reflects the very sociocultural impact on the individual's mind, revealing the dynamics among different voices and forces, including the individual's drive to influence the other forces. This framework seems to be very appropriate in the investigation of student motivation that is always influenced by various sociocultural factors and forces.

Second, qualitative research should be redefined as a process through which the researcher and participating individuals constantly negotiate in order to construct a shared meaning of the investigated phenomena. This process reflects the way in which reality is being constructed in society among various self-other relationships and competing forces. Social constructivists' argument for multiple voices, or polivocality, in a text supports that my study is a process in which many different voices are involved under a specific sociocultural milieu. Educational ethnographic studies, like many other qualitative research methodologies, have been criticized for their dualistic assumption that separates the researcher from the participants while ventriloquizing the researcher's own voice throughout the research process (Fine, 1994). However, by recognizing the polivocality embedded in this study, I will be able to better understand the

complexity and dynamics of the sociocultural context of young adolescent girls' motivation for school mathematics as well as the nature of my own research process and its final product.

CHAPTER 4

METHOD

Research Design

This study is an ethnographic case study exploring the sociocultural context of young adolescent girls' motivation to learn school mathematics. I have chosen case study design as the basis for my research because it is one of the most appropriate and effective ways to investigate complex social units consisting of multiple components that are potentially important in understanding phenomena. As Merriam (1998) describes, case study design is very effective in producing a rich and holistic account of complicated social phenomena because it is "anchored in real life situations" (p. 41). Case study design has proven particularly useful for studying current educational processes and problems, which ultimately aims to affect and improve future practices.

Case Study Design

Case study design is one of the most frequently employed research approaches in many disciplinary areas, including educational research, which seek to reach an in-depth understanding of a specific situation, individual, event, or community. Even though researchers vary somewhat in defining the term, generally case study is viewed as a research design that focuses on intensive descriptions and analyses of a single unit or bounded system (Smith, 1978). According to Yin (1994), "case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p. 3).

Characteristics of Qualitative Case Studies

Merriam (1998) explains the three main features of qualitative case studies: particularistic, descriptive, and heuristic. Particularistic studies focus on a particular case, such as one specific

situation, event, program, or phenomenon. The final product of the descriptive mode is a rich and dense description of the phenomenon under investigation, whereas heuristic studies are designed to increase the reader's understanding of the phenomenon under study (Merriam, 1998). Merriam (1998) argues that, in the case study design, the researcher's main "interest is in process rather than outcomes, in context rather than a specific factor, in discovery rather than confirmation" (p. 19). Qualitative case studies have also accommodated a variety of disciplinary perspectives, such as concepts, models, and theories from anthropology, history, sociology, psychology, and educational psychology.

Ethnographic Case Study

Ethnographic case study, in particular, employs anthropological perspectives and research methods. The ethnographic case study is based primarily on long-term participant observation by a researcher as well as formal and informal interviews with people in the field. Other supplementary research tools are often employed, depending on the nature of the research problem, access to data, and theoretical orientation. These may range from conducting extensive archival strategies to using structured interviews and questionnaires.

The ethnographic case study, influenced by cultural anthropology that emphasizes cultural characteristics of various human societies and communities, also focuses on the culture of a school, a group of students, or classroom behaviors (Merriam, 1998). The ultimate goal of the researcher using ethnographic case study design is to understand or explain the very core cultural characteristics of the field, including the ways of feeling, thinking, and behaving among the indigenous people in the field. To gain a thorough understanding of the culture of the field, the researcher tries to collect a variety of data and information from different sources.

In most ethnographic case studies, observation serves as the primary data collection method because it provides a firsthand account of the situation or field under investigation (Hansen, 1979). Observation is usually combined with interviews and document analysis in order to present a holistic interpretation of the phenomena under study. The second data collection

method, interviewing, is especially effective in exploring the inner thoughts of participants. Other archival strategies, including document analysis and the examination of different artifacts from the field, are important tools that help researchers understand the context of their observations and interviews in the field, providing additional and objective supporting data.

Studies adopting ethnographic case study design are numerous. One type presents an analysis of the culture of a group, such as Mead's study (1961; 1928) of adolescents in Samoa. Another example is Fine's (1991) critical ethnographic study of a comprehensive high school in New York City.

Participant Selection

Overall sampling for this study was conducted according to "criteria-based sampling" (LeCompte, Preissle, & Teach, 1993, p. 69) or "purposeful sampling" (Patton, 1990, p. 169). The objective of this kind of sampling is to acquire an information-rich case that is most appropriate to answer the research question posed by the study. Therefore, I chose a specific school and two mathematics classes that seemed best suited to answer my research question.

Site and Teacher Selection

Two different sixth grade mathematics classes in a small rural middle school were selected for this study. One class, designated as the "advanced math class" or "fourth period", consisted of students who had scored in the 85th percentile or higher on the ITBS the previous year. The other class, second period, was one of three "regular" math classes in sixth grade. However, the second period class was composed of students who had scored lower than the students attending either the third or seventh period regular math class. The same mathematics teacher taught both of the observed classes. Although students in the two classes used the same mathematics textbook, the teacher implemented the overall curriculum and modes of instruction based on her understanding of the students' potential level of achievement in each class. The teacher often supplemented the advanced class text with various enrichment materials from the seventh grade mathematics book or other resources, while skipping some segments of sixth grade work in the regular class. As a

result, there were significant differences between the two classes in their curriculum contents, rate of progress, and modes of instruction, along with the commonalities based on the use of the same textbook as a primary source of teaching and learning.

This institution was the only middle school in its large school district and accommodated students from the entire county. For this reason, the student population varied in terms of ethnicity and SES. In each grade, five teachers formed an interdisciplinary team teaching the entire grade except for a few particular classes.

I selected this specific school, with a total student population of about 480, based on the following criteria.

First, I wanted to focus my study on sixth grade girls and their mathematics classes because these students are in a transitional stage. Many previous studies have pointed out that young adolescence is a critical time in the development of girls' motivation and academic identity in many male-dominated disciplinary areas, including mathematics. Around this time, young adolescent girls begin to be aware of various sociocultural pressures on them and tend to lose their own inner voices and confidence in their ability to learn mathematics. I also selected this school and these classes because they included a variety of students in terms of achievement, ethnicity, and SES. Since I wanted to explore the sociocultural context of girls' motivation for learning school mathematics, selecting a school and classes that possessed such characteristics was critical. My selection of classes was based on the teacher's strong reputation as an effective and caring instructor, widely acknowledged for motivating her students to learn mathematics. Before deciding on my research site, I observed her teaching two of her classes. The teacher's favorable attitude and willingness to participate in this study also influenced my decision. In addition, the school administrator's positive response in the beginning and his continuing cooperation throughout the spring semester enabled me to conduct my study at this school.

Student Selection

All seven young adolescent girls whom I had invited as possible interviewees participated in this study. All were sixth graders in the two classes described above. Four participants came from the advanced class (fourth period), and the rest were from the regular class (second period). Student selection was conducted after my initial observations of the two mathematics classes and my first interview with the mathematics teacher in February 2001. Each student was selected with consideration of her status in relation to the following four criteria: ethnicity, class, mathematics achievement level, and attitudes and behaviors in mathematics class (see Table 2). Students' SES was determined by multiple factors, including parents' education level, occupation, residential area, and type of house.

Since the participating students were minors, a parental consent form and the student's assent form (see Appendices A and B) were acquired before I interviewed each student. These consent and assent forms provided the families with information about the study and their rights in the research process.

Data Collection Methods

Three different data collection methods were employed in this ethnographic case study: participant observation, interviews, and archival strategies, including document analysis. In this study, observation, particularly of each class and other sites within the school, was an important data collection method, providing me with firsthand evidence of the classroom situations and school environment in which teacher-student or student-student interactions took place. The second method, interviewing, was equally important, leading me to an in-depth understanding of the students' experiences and their own interpretations of them. In addition, archival strategies yielded more objective data, enabling me to cross-check and situate my observations and interviews within a larger context. The detailed uses of each method in this study are described below.

Participant Observation

I visited and observed the two achievement-grouped mathematics classes twice a week from February through May 2001, audio-taping each class observed. In addition, I observed other relevant or important sites in the school in order to understand the phenomena under study. The most frequently observed places were the homeroom period and other classes of participating students, the library, the school cafeteria, the outdoor playground, the indoor gymnasium, and the teachers' lounge where the casual conversation between the mathematics teacher and the homeroom teacher took place. I also observed other sixth grade mathematics learning situations, including one special education math class, one Title I math class, and one remedial class, called SWIS (School Within School). Students in the remedial class spent most of their time with their homeroom teacher and another teacher who taught the other sixth grade SWIS class. I did not audio-record the lessons I observed in these mathematics classes, but I did record some important aspects of those sites relating to the research question in my observational log so that I could incorporate the data into my observational research.

My role as a participant and observer varied depending on the situation of each mathematics class and other sites in the school. Generally, however, I limited my involvement in each situation, presenting myself as an observer rather than an active participant in various activities in the field. For example, I rarely initiated instructional assistance unless the teacher or students actively sought my help or involvement. I was careful not to change the course of instruction designed by the teacher or the flow of thought or problem-solving processes among students.

I used an observational log during each visit to summarize the most significant aspects of daily observations in the two mathematics classes. I also kept a reflective journal throughout the entire research process so that my daily reflections and thoughts concerning research processes would be recorded in a timely manner.

Table 1 describes the major focuses of my inquiry during classroom observation. The table was based on Merriam's model (1998, pp. 99-100) and revised to address the research question of this study.

Interviews

I interviewed three different groups of participants in this study: the mathematics teacher, the seven participating female students, and additional school personnel, including three other teachers of sixth grade mathematics. The interviews ranged from in-depth open-ended exchanges to intermittent, informal conversations with the people in the field.

Table 1

Observational Focuses and Possible Questions

Focus of observation	Possible questions for observation
The physical setting	What is the physical environment of the field? How is the space allocated in terms of students' gender, achievement levels, SES, and other sociocultural factors? What kinds of behaviors are expected in the setting? What kinds of sociocultural assumptions lie behind the expectations? What objects, resources, and technologies are in the setting? What are their sociocultural implications?
The participants	Who is in the scene, in terms of gender, achievement level, SES, and other sociocultural factors, and what are their roles? What are the characteristics of the participants? What brings these people together? Who is or is not allowed to be here, and does the answer to this question reflect any sociocultural aspects of the field?
Activities and interactions	What is taking place? Is there a definite sequence of activities? How do these people interact with each other? What norms and rules structure activities and interactions, and what are their sociocultural contexts and implications?
Conversation	What is the content of conversation, and what kinds of sociocultural issues are reflected in the conversation? Who speaks to whom? Who listens? What are the power relationships among participants?
Subtle factors	What kinds of informal and unplanned activities occur? What are the symbolic and connotative meanings of words used in the setting? What does *not* happen? Does it reflect any sociocultural issues?
Your own behavior	What is my role? How do I affect the scene? What do I say and do in the field?

Teacher interviews. I conducted three in-depth interviews with the teacher during the semester, the first taking place in February and the second and third in April. These interviews were based on a loosely organized interview protocol, allowing me to modify open-ended questions during the interview process (see Appendix E). The purpose of the each interview was to acquire the information about the teacher's perceptions and understanding of her teaching and the students' learning of mathematics in the classes. In the first interview, questions focused on the teacher's personal and professional background, general beliefs and attitudes about mathematics, her definition of and strategies for good mathematics teaching, and her overall perceptions and understanding of students' attitudes toward and motivation for mathematics learning. The subsequent interviews focused on the teacher's evaluation of each participating student's potential for learning mathematics and the teacher's relationship with their families. These interviews also included questions related to specific events observed in the classroom during the study.

Besides these three in-depth interviews, I had intermittent informal conversations with the teacher before or after my class observations throughout the semester. I believe this helped me to better understand the teacher's own interpretation of the various classroom situations, thus clarifying her beliefs in and attitudes toward mathematics learning and her students.

Student interviews. I conducted three in-depth interviews with each of seven participants. The first interview was guided by a loosely organized protocol containing several possible open-ended questions (see Appendix D). In the second and third interviews, questions given to each participant diverged, depending on the results of their first interviews and my observations in their mathematics classes. The purpose of the interviews was to understand the young adolescent girls' perceptions and understanding of school mathematics and their experiences with learning the subject. I focused specifically on the motivational aspect of their experience with school mathematics and the impact of various sociocultural factors or forces upon their experiences and

thoughts. The interview process also provided the girls with a chance to reflect on their past experiences with and thoughts about school mathematics.

I conducted the first interview with each participant in early March 2001, the second in April, and the last in late May. More than half of the second and third interviews were conducted either at my home or at the participants' homes with permission of their parents. In addition to the three formal interviews, I had numerous informal conversations with participants and their friends in various places, including their classrooms, the school cafeteria, the playground, their houses, the school bus, the local shopping center, and public parks throughout the research process.

One of the challenges of interviewing young adolescent girls was getting them to talk honestly about their perceptions of and experiences with school mathematics. I used three different strategies, depending on the specific situation I confronted. First, I clearly differentiated myself from other adults in the school whose main responsibility was monitoring students for instructional or disciplinary purposes. I positioned myself as a foreign observer or friend who knew little but wanted to learn about their experiences with school mathematics. Second, I made an intensive effort to establish good rapport before I conducted interviews with students so that they would talk honestly about their experiences with school mathematics. Last, I conducted the majority of second and third interviews outside the school context. After establishing rapport with participating students, I suggested various places, such as their homes or a public library, where they might feel more comfortable talking about their experiences. Most of them had at least one interview outside the school; the single exception was a participant who said she did not feel uncomfortable in the school setting. Students who expressed a high level of anxiety in their mathematics classes preferred to hold their interviews away from school. In these cases, interviews at their homes tended to become either casual conversations between the researcher and the student or storytelling by the student. At times, the interviews at home lasted considerably longer than the first sessions at school, since there was little time restriction and the interviewees tended to speak more freely and in greater detail about their experiences.

Additional interviews. When I realized that I needed more in-depth information to better understand the context of the mathematics classes I observed, I conducted formal or informal interviews with additional school personnel. These sessions included formal interviews with two other teachers of sixth grade mathematics. One was the homeroom teacher for one of two sixth grade SWIS classes in the lower hall, and the other was a newly hired teacher who was teaching sixth grade Title 1 mathematics in the lower hall. Both interviews were based on a loosely organized protocol focusing on the teachers' personal and professional experiences, their perception of students, and their approach to teaching mathematics in their own classes (see Appendix E). Each interview lasted about 50 minutes, and both were audio-recorded and later transcribed.

Ongoing informal conversations with various school personnel became an invaluable part of this study. I recorded numerous conversations with a librarian (the only African-American faculty member at the school), African-American custodians, other teachers, and parents who visited school during the study.

Archival Strategies

The archival strategies used in this study included document analysis and artifact examination. The main sources of archival data were public and personal documents as well as physical artifacts from the site. The public documents included various types of information about the community, the school district, the school, the mathematics curriculum, and related matters. I obtained most of this information from the school library, the middle school principal's office, and the local library. Personal documents refer to items such as students' writing assignments, their worksheets, and the teachers' daily memos for instructional or managerial purposes. I collected or copied these materials as they became available in the classroom. Artifacts that I obtained from the site included various types of OHP materials for instructional purposes as well as a number of students' creative or artistic works, such as their drawings and collages.

Data Analysis Methods

In general, qualitative data analysis involves three stages: description, development of themes and categories, and making inferences regarding the theoretical frames or assumptions (Merriam, 1998). Qualitative researchers, however, often find themselves engaged in more than one stage of their study simultaneously (Coffey & Atkinson, 1996; Hammersley & Atkinson, 1995; Merriam, 1998). This is especially true of an ethnographic study, which is based heavily on dense descriptive data gathered by the researcher. A researcher's description of the field inevitably includes his or her implicit or explicit examination and interpretation of the field. As Wolcott (1994) states, it is hard to say "where description ends and analysis begins, or where analysis becomes interpretation" (p. 11).

As I transcribed large amounts of classroom observation data during the data collection stage of my study, I became aware of this complexity. At first, I thought that transcribing each classroom observation was a descriptive process based on what had been recorded on the tape and in my observation log, as well as what remained in my memory. However, I soon learned that the descriptive process of observation data was, to some extent, intrinsically involved in my own interpretation of each situation. Furthermore, I began the initial coding when I was still engaged in the descriptive data collection at the research site. Also, I wrote notes on theoretical reflection, including several possible explanations of my observations during this period. Therefore, I was continuously involved in more than one stage of data analysis throughout the study.

Constant Comparative Method

The data analysis for this study was based on the constant comparative method. Generally speaking, this method involves four stages of data analysis (Glasser & Strauss, 1967). The first stage involves a comparison of incidents applicable to each category as the researcher codes different pieces of data. The second stage includes the integration of categories and their properties, resulting in the development of a theory. In the third and fourth stages, the researcher delimits the categories and theory and writes the theory.

I chose the constant comparative method for two reasons. First, this study focused not on the development of a grand theory or the close examination of a certain hypothesis, but on constructing or creating small theories deeply contextualized in the sociocultural milieu in which the study was conducted (Glasser & Strauss, 1967). Rather than striving for generalizability, my first priority was to find explanations for the complexity and dynamics of the case under investigation. Second, the constant comparative method is recognized as one of the most flexible data analysis methods in qualitative research. This strategy, despite the objectivist approaches of its founders, is widely used by researchers because it permits them to analyze empirical qualitative data from varied theoretical perspectives, such as Marxist, feminist, and phenomenological points of view (Charmaz, 2001). This method also allows for varied data gathering approaches as needed and easily accommodates different levels of analytic emphases and theoretical positions. The data analysis process used in this study is described in greater detail below.

Detailed Processes of Data Analysis

I went through four different stages of data analysis. The first three--reading through data and developing initial categories, identifying properties of each category and developing the theory, and solidifying the categories and delimiting theory--were based on the constant comparative method and practical advice from Hammersley and Atkinson (1995). At the outset, I carefully read through all the different types of data: observation data, interview transcripts, and archival documents and artifacts acquired from the research site (Hammersley & Atkinson,1995). Then, based on my preliminary understanding of the overall data, I constructed a list of possible categories, which I used as a steppingstone to a more detailed categorization process. At the beginning of the second stage, I used a qualitative data analysis program, Nudist 5, which was designed to help researchers efficiently conduct constant comparative analysis with qualitative data (Weitzman & Miles, 1995). I conducted detailed categorization of all data, including some archival data that had been transformed into a Word document. Throughout this process, I

constantly added new entries into my data analysis reflection journal whenever I created a new category, discovered another possible interpretation, or had an unanswered question in mind. The categories became more sophisticated and meaningful, and many small, incomplete themes emerged, during this stage.

The third stage consisted of clarifying the relationships among refined codes and their properties while searching for the main themes recurring throughout the data. I classified, networked, and integrated different categories based on their interrelationships. This work led me to develop a set of potential theories or findings from the data. During this stage, I revisited the existing literature for two different purposes: first, I wanted to compare the potential theories emerging from the data with the findings in the existing literature. I determined which of my potential findings were supported or not supported by previous studies. This process allowed me to reevaluate my potential findings and to consider other possible interpretations that I had not previously recognized. My second purpose in reviewing the literature was to increase my understanding of several themes that emerged from the data. There were unexpected phenomena and relationships that I was unable to explain with confidence. For example, data from one African-American participant identified a major impact of the "success through sports" ideology, which I had hardly expected in the beginning of my study. Hence, I began to search beyond my immediate parameters for existing literature that would help me to better understand and interpret the phenomena. I then introduced a theory applicable to the entire data set and compared the variations in each case, e.g., each of the seven participants and their classroom settings. In this stage, I took particular care not to lose insight into the different properties and interrelationships existing within a category. Finally, I constructed a large but rather loosely stratified structure that revealed the main themes and core relationships emerging from the data.

The last stage was one that I had not predicted at the start. Throughout my data analysis, I believed that it would be very important, even essential, to emphasize the context and uniqueness of the research site and the participants in my final report. Even though I found several

penetrating themes and common relationships in the complete data set, each of the participants in this study, the teacher and seven girls, painted a unique picture of herself. The sociocultural milieu in which each individual was situated was different from that of the others. Furthermore, they practiced contrasting modes of individual agency within the context. The distinctive complexity and dynamic pulsating in each person's case were so profound and fascinating that it seemed almost impossible to convey the unique profiles without giving each participant a spotlight. I had to admit that the uniqueness of each of their worlds constituted the essence of my finding, along with the overarching main themes that encompassed the full range of data. Therefore, I decided to present my findings by cases rather than reporting the main themes and variations in a single stratified structure.

Because I decided to focus on each case in my findings, I had to finish an additional stage of data analysis. In this final stage, I retrieved my data and constructed ten small trees, representing the structure of each case: a. school and community context; b. the teacher; c. the classroom; and d. seven trees for seven students. At this point, I found that two participants, April and Heather, had generated findings similar to those of Amanda and Celestina respectively. To avoid redundancy, I decided to include only Amanda and Celestina in my report, along with three other girls, Jessica, Stella, and Rachel. I chose to present Amanda rather than April because I wanted to include in this study at least one Caucasian girl from a non-middle class background. Amanda's profile, a once high-achieving girl from a working class family whose grades recently plummeted, was more interesting to me than that of April, a Caucasian girl from a middle class family. I chose Celestina, rather than Heather, because Heather's data turned out to be sparse due to the decline of her motivation throughout the project. In addition, I was able to meet and communicate with Amanda and Celestina's family members during the project, which helped me document richer and more diversified records about them. However, I included excerpts from April's and Heather's interviews/analyses so that their voices would be heard in my study. Table 2 shows the profiles of seven students, including April and Heather.

Throughout the writing process, the large umbrella themes were woven into each case so that all eight cases were interconnected and mutually informed each other. My final data analysis stage, which was closely bound to the writing process itself, was partly guided by narrative analysis (Riessman, 1993). I used Reissman's strategy for data reduction to reduce the numerous chunks of coded interview data to the core narrative. She also stated that a researcher should recognize that an "individual's narratives are situated in particular interactions but also in social, cultural, and institutional discourses, which must be brought to bear to interpret them" (p. 61). Since this project was an ethnographic case study, which paid close attention to a larger sociocultural context, including the community and school environment, the cases of individual participants were embedded in the relevant background analysis. In other words, individual profiles in this study were constructed within a larger sociocultural context in which the participants' narratives had been constructed and shared with me, a stranger.

Validity Issues

Validity is generally acknowledged to be an important component of any good qualitative study design. Maxwell (1996) defines validity as "the correctness or credibility of a description, conclusion, explanation and interpretation or other sort of accounts," (p. 87) and suggests

Table 2

Ethnicity, SES, & Current Mathematics Achievement of Student Participants (not reported as a separate case)*

Level of class	Name	Ethnicity	SES	Achievement level in the current math class
Advanced class	Amanda	Caucasian	Working class	Low
	April*	Caucasian	Middle class	Middle
	Jessica	Caucasian	Middle class	High
	Stella	African- American	Working class	High
Regular class	Celestina	Hispanic	Middle class	Low
	Heather*	Caucasian	Middle class	Low
	Rachel	African American	Working class	High

multiple-layered strategies that help minimize validity concerns in a qualitative study. In this study, I adopted several strategies to minimize such concerns.

First, I made it clear in the beginning of this study my theoretical perspectives and what kinds of lenses I am using in this study. In fact, this greatly helped me to experiment with different interpretations of data because I knew that I was looking through a particular lens and there were other possible interpretations of the same data. I became more aware of the part of my data which did not fit well into my initial theoretical framework. Also, I actively sought for a re-structuring of my theoretical framework so that it could explain those discrepancies and unexpected challenges.

Second, I gathered data from various sources using multiple methods. I adopted observation methods, in-depth interviews, and archival searches in and out of the school and community. I did not limit my observation to the two mathematics classes, but visited as many places as possible within the school at different times. I interviewed, both informally and formally, other teachers and students at the school and documented their responses as well. Also, I participated in different school activities so that I could communicate with parents and observe their interactions with teachers. Therefore, this study not only includes the major participants' voices but also contains many others' voices as well.

Third, I conducted continual member-checks and peer-checks throughout the data collection, data transcription, and analysis process. All interview data and parts of the observation data were transcribed and proof-transcribed by two people, a professional transcriber and myself. The professional transciber was a Caucasian-American woman who understood the cultural environment of the region and southern dialect spoken by some of my participants. I had my participants review their interview transcripts, and received their feedback. I also shared with my mentor and colleagues examples of my interview transcripts, which had my initial reflection notes on them. My observation log was also shared with them in the same manner. Through this member-check process, I received their feedback regarding the quality of my interviews,

classroom observation, and persuasiveness of my initial interpretation or reflection notes. In addition, I presented initial interpretations of the data in a few professional conferences and incorporated the audiences' questions and feedbacks into the subsequent data analysis process.

Fourth, I actively sought quasi-statistical data to support my findings. For example, I counted some particular words spoken by each participant in order to contrast their confidence or motivation levels. I regularly documented different types of descriptive data, such as the number of students, boys and girls, Caucasians and African-Americans, in different classrooms or other school settings at different times. These quasi-statistical data were relatively free, though not absolutely free, from my own subjective judgment and interpretation of each situation under investigation.

CHAPTER 5

FINDINGS: COMMUNITY, SCHOOL, AND CLASSROOM CONTEXT

The three subsections of this chapter focus respectively on findings about the community and school contexts, the mathematics teacher, and the classroom environment as experienced by the five participants. To ensure confidentiality, all names used in this and the following chapter are pseudonyms, and certain information that might identify the community, school, or individual participants has been deleted.

Pine County and Pine County Middle School

Pine County Middle School (PCMS, pseudonym) is the only middle school in Pine County, a traditional southern rural county located in the Southeast. During this study, PCMS with 480 students was not a large middle school by any means, but it constituted one of the largest school districts in the state because it was the only middle school in the county. PCMS had the same address as Pine County High School (PCHS). Both schools shared the main office building in the middle; in fact, the principals' offices were next door to each other. Two large halls to the right of the main building housed PCMS and the two halls to the left were assigned to PCHS. Most of the students at PCMS and PCHS were bused from all over the county, making the student body rather heterogeneous. The majority of adolescents in Pine County attended either of the two schools unless their parents sent them to a private school in a nearby city. Approximately seven percent of school-aged children in the county, mostly Whites, attended a private school. As a whole, PCMS, like PCHS, was a "community school" where everybody in the county got to know each other.

Pine County was a rather isolated rural county of approximately 12,000 residents, remote from any bustling metropolitan area. During the last three decades, it was a traditional, quiet rural area populated with independent farmers and farm-related employees in addition to a small

number of people engaged in local businesses, such as fishing, mining, construction, and retail services (Oregon State University Information Services, n.d.). The Pine County School Board was the largest employer in the county with about 138 employees in 2000. All I saw in its tiny downtown area were a few gas stations, three new and used car dealers, two car repair centers, a pizza shop, a locally-owned grocery store, post office, and a commercial branch bank from a nearby city. Since few businesses and services were available within the county, people often drove to an adjacent community, Apple City, for shopping, services, and entertainment. Along the road to the city, several partially collapsed farmhouses were conspicuous. Apparently, farming, which had once been the main business in the county, no longer supported the quality of life that residents demanded. The number of farms gradually decreased during the last three decades (Rural Development Center, Cooperative Extension Service, & The University of Georgia, 2001). Many people, particularly the young, were quick to leave the county in search of new opportunities in Apple City or larger metropolitan areas.

In the 1960s, Pine County was the home of two ethnic communities of approximately equal size, African-American and White (Oregon State University Information Services, n.d.). Both communities had been living in the county for many generations. During the last three decades, the population of Pine County grew slowly but steadily, mainly due to the increase of White families moving into the county. However, unlike Apple City, which experienced a huge influx of Mexican immigrants over the last several years, Pine County did not experience a dramatic change in its ethnic composition. Since the county lacked local businesses and industries, it offered little incentive for people from outside to relocate there. The size of the Hispanic community in the county was very small compared to that of Apple City. A few Hispanic families lived in the county, but they did not share cultural or community characteristics with each other or with another Hispanic community in Apple City. Some Hispanic families that came from large northern cities preserved their strong ethnic identity and multicultural sensitivity, while others were almost completely assimilated into the local White communities.

The demographic changes that Pine County experienced during the past three decades were partly related to Apple City's own demographic changes, spurred by accelerating urbanization. Pine County absorbed a slow but steady influx of middle and upper class White people from Apple City and adjacent counties, gradually becoming home to a large number of professionals who commuted to their jobs (Rural Development Center et al., 1991, 2001). The majority of these families had school-aged children. In addition, there was a steady increase in the number of professional retirees who had worked in nearby cities. When they relocated, many purchased large farmhouses and became part of the local community. Although these changes were gradual, they resulted in a significant growth of the White community in Pine County.

The African-American community experienced different changes. Since the main industries in the county, such as faming, mining, fishing, and construction, did not support the quality of life that people desired, young African-Americans tended to leave in pursuit of better job opportunities. There were only four African-Americans who actually operated farms in the county compared to three hundred and fifteen White people doing the job (Rural Development Center et al., 2001). The number of newly-moved-in African-American families was limited compared to their White counterparts. As a result, Pine County's African-American community became relatively smaller than the White community. The 1997 census data identified the White community as the majority, comprising more than seventy percent of the total population in the county, while the African-American community remained at twenty-seven percent (United States Census Bureau, n.d.). The student population at PCMS also reflected these demographic changes. African-American students at PCMS decreased from thirty-four percent in 1991 to twenty-six percent in 2001 (Pine County Middle School Self-Study, 1995; Rural Development Center et al., 2001).

There was a significant economic disparity between the White and African American communities in Pine County. Statistics (Rural Development Center et al., 1984, 2001) show that in 1979, 33.2% of African-American residents in Pine County lived below the poverty line while

only 11.5% of their White counterparts remained below the poverty line. Few changes occurred in this pattern during the last three decades. In 1997, African-American residents still tended to live below the poverty line three times more than White residents: the median income of White residents ($27,007) was almost twice as much as that of African American residents' ($15,948). PCMS's student population clearly represented the social and economic geography of the county. Some students came from families who had lived in the county for generations and were still engaged in farming or in other small local businesses. These families showed a huge range in socioeconomic status. Some of them, owned large farms and were considered affluent, while others were struggling to make ends meet. However, the majority of the students' families traveled outside the county for employment. Many parents in this category were previous graduates of PCMS and PCHS working in non-professional jobs in Apple City or adjacent counties. After relocating, they settled down in the county and sent their own children to the same middle and high school they had attended twenty years ago. Others, comprising about twenty percent of Pine County residents, were the most affluent: middle and upper-middle class people who had recently moved from Apple City or adjacent counties. These parents were highly educated and held professional positions in Apple City. Not surprisingly, their social lives were closely related to various professional associations in the city, and they were actively involved in PCMS functions and PTO meetings, where they influenced school administrators' decisions.

Generally, low income and poverty plagued the lives of many PCMS students, particularly those from minority backgrounds. As a whole, about sixteen percent of PCMS students were living below the poverty level. About forty-four percent of PCMS students were eligible to receive free or reduced lunches (Georgia Public Education Report Card for Parents, 1999-2000; National Center for Education Statistics, n.d.; Rural Development Center et al., 2001). Yet, the percentages of school-aged children living below the poverty level differed significantly between the two ethnic communities. Less than ten percent of White children aged five to seventeen lived

in poverty, compared to thirty-two percent of African-American children of the same ages (Census Bureau, n. d., Rural Development Center et al., 2001).

Before racial desegregation occurred in the1970s, PCMS was a K through 12 school exclusively for Whites. During this period, the African-American community operated a separate K through twelve school for their children; eventually, this became the Pine County Elementary School. Each ethnic community maintained a lifestyle apart from the other, as was the case with their children's education. Such tendencies still largely persist. The residential area in the county exemplified the clear separation of one community from the other. African-American residents tended to live close to each other in several different residential areas in the county. For example, the residential area between Church Street and Hog Mountain Road, and both sides of Cherokee Road, were inhabited entirely by African Americans. In general, their residential areas were not as well maintained as the White areas were. Untended streets in some African-American residential areas were narrow and bumpy. Some areas were better kept, with small but nicely taken-care-of wooden houses lined up along the old, but at least paved, road. Other areas were in greater disrepair, with several rusty trailer homes that sat off an unpaved, muddy road. One African-American participant in my study lived in one of those rusty trailers squatting over a weedy lot at the end of a dirt road. In these areas, it was easy to meet a few -- and sometimes more than a few-- school-aged boys and girls at 10 a.m. on weekdays. During my first visit to one of these residential areas, I encountered a girl with a bored expression. She was sitting beside the door of her trailer home while her baby sisters ran around the weedy lot tumbling, screaming, and giggling with each other. On my second visit to the same area, I met a few boys, who appeared to be around eleven to fourteen years old, playing basketball. I wondered why they were there at 10 a.m. when everybody else was in school.

The relationship between the two major ethnic communities within PCMS was delicate. The school had no African-American teachers in the classroom. Mrs. Davis, the librarian, was the only African-American faculty member, having served at PCMS for the past twenty years. The

school was one of the Phi Delta Kappa Minority Teacher Recruitment Institutions looking for minority teachers, but it seemed to be very difficult to recruit minorities. In fall 2000, PCMS created a program, called "SWIS (School Within School)", accommodating about thirty-five low achieving sixth grade students in two smaller classes. The percentage of minority students in the two classes was much higher than that in regular or advanced classes in the same grade. Also, newly hired and less experienced teachers tended to teach those classes, often against their preference. Only a few African-American parents visited school on parent-teacher conference day or attended the awards ceremony, dominated by White students, on the Sixth Grade Honors Night. During the fundraising basketball games after the awards ceremony, White parents gravitated to seats on the left stand, while African-American parents sat on the right side of the audience. One African-American parent explained to me that she had to come to school that day in order to prove that she cared about her children's education, "because they think we don't care." Paula, a Hispanic eighth grader who had recently moved from New York City, stated, "Here, they treat you differently because you look different."

Pine County public schools had difficulty in educating minority students up to their potentials. During 1994-1995, the percentage of African-American students at PCMS was 36.5% while Caucasian students were 63%. After four years, in 2000, PCHS had 79 graduates: Among them, only 16.5% were African-Americans and 81% were Whites. The percent of class completion from 1996 to 2000 was 53%, making the dropout rate for this student cohort 47%. This was mostly due to the extremely high dropout rate of African-American students. Furthermore, among the total of 33 high school graduates in the cohort who received a college prep diploma, only 6.1% (2 in actual number) were African-American students and 87.9% were White. It is not surprising that the educational attainment of Pine County residents significantly differed by ethnicity. The number of African-American residents who did not complete high school was twice as large as that of Whites. Only 0.2% of African-Americans in Pine County held

a bachelor's degree and almost no African-Americans held a graduate or professional degree. In contrast, 16.3% of Pine County White residents had bachelor's or graduate degrees (see Table 3).

As in many places in our society, race and class were delicate issues, topics forbidden in school discussions. Few people wanted to talk about those issues, even though they were visible and palpable in students' lives and to me, a stranger in their midst. What the school advocated was a principle of blind justice, as described in its own published philosophy: "Pine County Middle School is dedicated to aiding and assisting all students in order to ensure their success. We strive to achieve an educational system that meets the needs of our students without regard to sex, race, religion, or ethnic origin."

The school and its employees genuinely wanted to help the students--all students-- succeed. The inherent contradiction was that they believed that they could meet students' needs "without regard to sex, race, religion, or ethnic origin." Clearly, they did not realize that helping students, particularly minority students, succeed was impossible unless they demonstrated genuine support of the cultural heritages and community assets of those students.

In some ways, PCMS administrators and teachers also suffered from the tragic past: slavery, segregation, and a position between two ethnic communities that showed little understanding of

Table 3

Pine County Residents' Educational Attainment by Race (people 25 years or older)

	White	African American
Less than 8th grade	12.3	34.0
Not completing high school	31.1	63.6
HS graduate	37.7	33.1
Bachelor's degree	9.0	0.2
Graduate/professional degree	7.3	0.0

each other, a consequence of the prevalent socio-historical milieu. The different economic, cultural, and social lives that the two ethnic communities experienced outside of the school contributed to the teachers' lack of understanding of their minority students, who comprised thirty percent of the student population at the school. Some people, including students and teachers who had recently come from outside the county or state, readily perceived the barrier. Both groups reported PCMS teachers' failure to understand minority students and their repeated miscommunications with them.

Fear, as described by one newly hired teacher, resided in many PCMS teachers' hearts. They were afraid that acknowledging and admitting any differences between the two ethnic communities would prejudice them in educating their students. Teachers at PCMS longed to be fair, even-handedly implementing justice in their classrooms so that their students would not repeat the tragic past. They believed that blinding themselves to ethnic and cultural differences was the most effective way to achieve true justice in their classrooms and at the school. However, they had not taken another important step on the road: acknowledging their students' differences and celebrating them as assets. That required a tremendous amount of courage, much more than the researcher as an outsider, who could only share a glimpse of their pain and burden from the tragic past, could imagine.

The Mathematics Teacher

Mrs. Oliver is well known around Pine County as an outstanding mathematics teacher. She has almost twenty-five years of teaching experience, including the last seven years at Pine County Middle School teaching sixth grade mathematics.

Meet Mrs. Oliver

On the surface, Mrs. Oliver looked rather distant and reserved. She was in her late 40s, about 5' 4", and slim. She had short, straight blond hair and a very fair, sometimes even pale, complexion. Her calm blue eyes sparkled under her glasses that somehow reinforced her image as one of the strictest teachers in the sixth grade hall. Mrs. Oliver wore hardly any make-up and did

not wear fancy dresses, yet she always looked neat. Her previous and current colleagues described her positively as an "excellent," "competent," and "very well-organized" teacher. She always looked well prepared for the challenges of the day as she stood quietly beside her classroom door looking down at her students entering the room in an orderly manner.

One interesting aspect of Mrs. Oliver was her method of discipline. She hardly ever raised her voice as she was monitoring students' behaviors during break. Few people, including myself, in the school had ever heard her yelling at any student in the hall. She knew how to monitor and control students' behaviors by just casting her deep and heavy gaze onto a particular student or a group of students. Students seemed to feel the prickling heat of her gaze even though that came from their backs. Her quiet eyes and firm attitude delivered to students more than ten thousand words.

However, Mrs. Oliver's calm and low voice dramatically changed once she started her lesson. Her voice turned into an extremely powerful and authoritative one. Even her pale face turned lively pink, making her a completely different person. Mrs. Oliver often suffered from a soar throat at the end of the school day because she strained her voice. Some students in her class loved her way of teaching. They deeply appreciated her passion and enthusiasm and were motivated by her dedicated attitude. To them, Mrs. Oliver was an example of a good teacher working really hard to help students achieve academic success.

Professional Background

Mrs. Oliver received her bachelor's degree in elementary education from Smith College, a small regional college in the Southeast where she met her ex-husband. They were married upon their graduation and started their first teaching positions in Florida. Mrs. Oliver described her first year of teaching as a very wonderful experience. "I always enjoyed teaching. I have never had a problem with getting up and going to school," said Mrs. Oliver. A few years later, Mrs. Oliver and her ex-husband moved to Pine County. Since then Mrs. Oliver worked in four different schools, one elementary school and three middle schools near the county.

Mrs. Oliver did not expect to teach middle school children in the beginning of her teaching career. She had a very clear preference for teaching elementary children, especially 3rd graders. "I loved third graders and I didn't think I would (teach middle school) because I always wanted to teach third grade," Mrs. Oliver said. It was rather coincidental that Mrs. Oliver started teaching middle school students. She left her third elementary school position after having learned that her new principal "didn't have the same philosophy of education" as hers. "About half of the faculty left that year," Mrs. Oliver recollected. Yet, she was still looking for another job in elementary school.

> I still wanted to have a job . . . . A friend of mine, a principal in a middle school of Warton, called me and said she had a math position. I told her no, I am not teaching at middle school. She said, "Just come and talk to me. Just come and talk." So I went to talk to her. The math position she had was a title math. The children were in low-level math. Some of the students were in elementary grades because it was also a K - 8 school . . . . She asked to me to try it. I taught the first year and loved it. Not only did I love the third grade, which I knew I would, but also I got along so well with the middle school children. I have been teaching math ever since. (First interview with Mrs. Oliver on February 16, 2001)

Experience with Learning School Mathematics and Professional Development

Mrs. Oliver was not a person who fell in love with mathematics during her school days. She clearly remembered herself struggling with mathematics at some points of her life. Yet, she took to it positively for her own teaching.

> I was never a strong math student. I will tell my children that I was not a strong math student. It took me forever to learn long division. I remember [when] I could not do a long division. I could not catch on to what we were doing. I remember in elementary school, in fourth grade, I guess, the teacher would send us to the board to work out long division problems. I was standing there begging somebody beside me to help me because

> I didn't know how to do it. . . . . So I emphasize when they don't understand what's going on. I can work with them to get them to see what's going on because I was not strong in math." (First interview with Mrs. Oliver on February 16, 2001)

Mrs. Oliver described her mathematics learning as a gradual process based on her hard work. Though she "was not real strong when [she] first started in school in math," she "began to pick up" and could "understand a little better" as she persisted on the task. Then, the time came to Mrs. Oliver when she "could understand what they couldn't understand."

However, Mrs. Oliver's professional training in the area of mathematics was rather weak. She had few chances to take any additional training or courses for teaching middle school mathematics. She could not remember any professional training programs, mentors, or instructional support that had been available or helpful to her. Responding to the researcher's question asking if there were influential people in her professional development as a mathematics teacher, Mrs. Oliver said, "I cannot think of one person that influenced me."

In general, Mrs. Oliver's professional development as a mathematics teacher was isolated from the professional community of mathematics educators. Teaching middle school mathematics was not something she intended to do in the beginning of her professional career. It was by chance that she stepped into middle school and discovered her talent as a good middle school mathematics teacher. Since her first job at Warton, Mrs. Oliver had continued teaching middle school mathematics without having an opportunity to further her professional development in the subject area. Warton Middle School's urgent need for a mathematics teacher to teach a chapter class, and chronic shortage of qualified mathematics teachers in middle grades actually enabled Mrs. Oliver to continue teaching middle school mathematics for the last fifteen years.

Mrs. Oliver's professional development as a middle school mathematics teacher was a lonely journey heavily based on her own teaching experience with middle school students, particularly sixth grade students. She was not encouraged to further her professional development while serving as a mathematics teacher at three different middle schools in and out of the county.

As a result, her professional development in mathematics education was very limited, greatly affecting her understanding of mathematical knowledge as well as her instructional modes. Though Mrs. Oliver felt very confident about her ability to teach sixth grade mathematics, her lack of professional development posed some challenges. She suffered from the same problems that many rural teachers tend to have—lack of support in professional development and, as a result, a deep separation from the professional community of educators (Wigle & Sylvester, 1996).

Mrs. Oliver recently realized her weak professional background in middle school mathematics posed a serious problem in her career. During the last two years the state education department changed the regulations twice regarding the qualification requirements for middle school teachers twice. "There was a change in our certification. And because I do not have twenty hours of math in college they won't let me teach math. I have been teaching math for twenty something years and I was very upset about this. I tried to tell them, 'Look, I've been teaching math twenty something years and you are telling me I am not qualified to teach math.' They said, 'That's right.'" Feeling hurt and angry, Mrs. Oliver "signed up for college algebra online, only to pull [her] hair out." "Fortunately, since then, they have changed that bill [sic]. Because I have been teaching five years in my area, I don't have to have twenty hours." Though the crisis ended leaving her qualified for teaching middle school mathematics, Mrs. Oliver reflected on the incident as "miserable" and "a very bad experience." It seriously threatened her confidence as one of the most outstanding mathematics teachers in the county. It was definitely a very hurtful experience.

Understanding of Mathematical Knowledge

Mrs. Oliver's understanding of mathematics or mathematical knowledge was not much different from what has been reported in mathematics education literature. Previous studies have reported that the majority of mathematics teachers have a static and mechanical understanding of mathematical knowledge (Ball, 1990; Brown, McNamara, Hanley, & Jones, 1999). She had a

very static and abstract image of mathematics, which defined mathematics as a firmly established set of knowledge with little flexibility and few possible changes. She emphasized "the basic four operations" as the essence of mathematical knowledge. Her explanation of possible uses of mathematical knowledge in our lives was rather limited: Counting money, writing a checkbook, and using measurement for cooking were some examples she often cited in her classes.

> J H: What is your general belief about mathematics or mathematical knowledge? What kind of feelings or ideas do you have or come up with the word of mathematics.
>
> Mrs. Oliver: Numbers, numbers, numbers. Basically I think of just basic four operations, add, subtract, multiply and divide whether it is with whole numbers, fractions, and decimals. I think that is what we use a lot. What I like my children to know is why they are going to use it. Math is something you use everyday, everyday [emphasized]. Mathematics is so important because everyone uses it in some way. Students need to know math is a life skill. Part of life is doing math.
>
> J H: For example?
>
> Mrs. Oliver: For example, when you go to a grocery store I tell my students I am estimating. I use estimating a lot. You don't always have to know the exact number but you can estimate so you won't get up to the register embarrassed by not having enough money. Students can identify with some of these things and bring it into real life. Another example is keeping an accurate checkbook. I don't want to estimate in my checkbook. I want my checkbook correct to the penny. So there are some places you can estimate and some places you have to have the exact number in real life everyday. (First interview with Mrs. Oliver on February 16, 2001)

Not surprisingly, Mrs. Oliver's conception of mathematics as a body of knowledge that she possessed and that her students must learn determined her approach to classroom teaching. She stated, "I always know that I've got something I am going to show them," and developed her instruction based on this assumption. It was her sacred responsibility to teach the knowledge to

"help them [students] out with it … make them so comfortable with it." She perceived herself as a knowledge possessor whose primary responsibility was to distribute an appropriate piece of knowledge to her students. On the other hand, students were viewed as recipients of knowledge who passively received the piece of knowledge delivered from the teacher. Mrs. Oliver's image of teaching and learning mathematics strikingly reflected the "nutritionist view of knowledge" and its "depository" method as criticized by Paulo Freire and other critical theorists (Freire, 1998).

Mrs. Oliver seemed to have difficulty acknowledging that human knowledge, including mathematics, was constantly changing and advancing. She also failed to recognize that individual students were not passive recipients but agents who created meaningful knowledge through constant interaction with others, such as their teachers and peers. In fact, her classes demonstrated pitfalls of the "depository method" or "transmission model" of instruction. For example, for each chapter in the textbook she prepared many different index cards filled with facts, formulas, and steps to solve particular types of problems. These were designed to help students memorize the facts, formulas, and steps for problem solving. In my classroom observations, I often found that some students barely grasped the concepts underlying the facts, formulas, and processes listed on the index cards. Yet, students were often able to solve given problems by following the piecemeal approach of formulas and steps.

Enthusiasm for Teaching

One characteristic that stood out in Mrs. Oliver's teaching was her enthusiastic attitude toward her own teaching. Her enthusiasm was based on her strong confidence in her ability to teach the subject effectively, and her conviction that her students would appreciate her effort someday, though not today. In the following excerpt, Mrs. Oliver used the word *excited* five times describing her general feeling in the mathematics classroom.

> J H: Could you tell me your general experience? What kind of thoughts and feelings do you have when you are teaching in your math classes?

> Mrs. Oliver: When I introduce a new lesson, I am always *excited* about it. I always know I've got something that I am going to show them that's going to help them. I try to make them comfortable with it. Every time I am doing a new lesson I *get real excited* . . . most of the time. I just *get excited* when we start a new lesson, especially exponents and the things that I know they have never seen before. If it is something new to them, like positive and negative integers, I knew it's going to be new to them and it's *just exciting* to me to teach them the thing that they haven't seen before. When they do it and they'll always say, 'I remember this' and 'I can do this.' That's fine. I enjoy helping them in that. But something new that I know is going to be new to them and I can be the first one to teach them that. It's a good feeling. *It's exciting*. (emphasis added) (First interview with Mrs. Oliver on February 16, 2001)

Mrs. Oliver described an incident when her principal visited her. He was so curious why she was so excited with her upcoming lesson on that day. "It is one of my favorite lessons … about exponents." Mrs. Oliver loved teaching something advanced or a challenge because she expected her students would meet that challenge. "You know, if I just teach low, they will stay low. But I tried them and challenged them. And most of them, it's just amazing." Mrs. Oliver's enthusiasm for her own teaching was contagious. It was like a virus floating in the air of her classroom and infected the majority of students as they simply breathed. Some students even felt a kind of moral and ethical obligation to undertake the given challenges in the classroom responding to the teacher's passionate instruction and effort. For example, Jessica described Mrs. Oliver as "an excellent teacher…because she's worried about our class." Jessica viewed Mrs. Oliver as a teacher who eagerly "went over them [problems] . . . if they [students] need extra help." Jessica believed that all students in the class "should be thanking Mrs. Oliver" because "she chose to teach and show them, to help them understand what they're going to need . . . tomorrow."

Conflicts

However, Mrs. Oliver's professional life as a schoolteacher was not always easy. Though she believed she was a good teacher, she was not immune to the various ups and downs every teacher experiences throughout their professional journey. In particular, the reality in which many teachers find themselves now seems to get only worse than previous decades. During the last twenty years, public schools across the country have been under the attack of mass media and politicians, who advocate market principles in public school reform. The majority of current educational reforms initiated by the state and federal governments deprived schoolteachers of professionalism and agency in their own work, and treated them as the main target of educational reforms, which had to be manipulated and engineered. Mrs. Oliver and her school were not free from this larger socio-political context. Mrs. Oliver knew that the media's criticism and many government-initiated reforms in public school education were not something she could comfortably agree with. Furthermore, some of those reform initiatives threatened her professional confidence and self-worth as a hard-working and outstanding mathematics teacher. In her first interview, Mrs. Oliver described her strong concerns for upcoming changes in public school education and expressed her uncomfortable feelings, hurt, and even resentment about such pressures.

Pressure from accountability. One of the recent school reforms that disturbed Mrs. Oliver most was the blind use of standardized test scores to evaluate students' academic performances. PCMS students took two standardized tests each spring. Mrs. Oliver found that these tests often made it impossible for her to run an appropriate and naturally sequenced curriculum for her students. She was confused and frustrated because her ideas and professional judgment about her own teaching, such as what to teach, how to teach, and when to teach, have been mostly denied under the coercive pressure from the mandated state exams. She deplored that the state-mandated exams actually impeded the natural flow of her teaching, the most effective and relevant way of teaching mathematics for her own students. She believed that "the ideal teacher would not be in

such a rush that you have to get to a certain place at a certain time" considering the unique needs of his/her students. After a deep sigh, Mrs. Oliver said, "This is little bit hard, (paused) because we have the Stanford 9 test and we have the CRCT test that we are accountable for." She knew the distance between her ideal of good teaching and what she had to do in the "real world." She described one incident a few years ago when students were tested on fractions they had not learned yet.

> I remember here a couple of years ago, it was actually right after I started here, they told the teachers and sixth grade teachers in particular their children were not doing well and why don't they do better in math? That was in early March and we had just started fractions like we are doing now. We are just beginning. They gave the test. We took the test and the students couldn't do it because I hadn't taught it yet. And I told them, "We haven't gotten to fractions yet." They certainly hadn't done enough to know how to do them (fractions) and their scores were bad. So the principal said, 'You need to rearrange your curriculum.' So we did that. So I started teaching fractions much earlier. (First interview with Mrs. Oliver on February 16, 2001)

Mrs. Oliver did not like the idea of teaching fractions early because of the test. She believed that students were not really ready for that in early spring and they should learn them later. Yet, she was forced to teach fractions earlier because the standardized test was in the middle of spring semester. Her knowledge about her students' pace of learning was not appreciated, nor could she practice her professional judgment regarding the best sequence of curriculum in her classroom. Under this circumstance, her ideal of a good mathematics teacher or teaching was an impossible dream. She was concerned about the consequence of the jumbled and ragged curriculum under the pressure of state mandated standardized tests. Her deep sigh revealed her frustration, recognizing the huge gap between her ideal and reality. "I have to go on sometimes when I don't feel like the students are ready to go on, when they have not mastered the concept." She felt that she was deprived of the most important decision-making that would affect her own

teaching and students' learning. She felt the state mandated curriculum and tests were manipulating her even though she could not agree on the philosophy of such reforms. Mrs. Oliver did not know where and how she could make her voice be heard and influence those reform efforts for the betterment of her students' academic learning. Unfortunately, there seemed to be no way for such communication to be available to her. She was just frustrated, separated from other teachers who might have felt the exactly same feelings and hurts as hers.

Teaching for more than a good grade. Mrs. Oliver had another source of pressure, which made it difficult for her to follow her own ideal of good teaching. Mrs. Oliver believed that some of her students needed an extra challenging curriculum so that they could maximize their mathematical potential. She thought learning a higher level of mathematical knowledge was more important than just making them happy with high grades on easy tests. However, Mrs. Oliver met strong resistance from parents as she introduced a higher level of mathematics in her advanced math class. Parents were not aware of the importance of such challenges in their children's long-term intellectual development. They were more interested in short-term consequences represented in their children's grades and test scores. In the end, Mrs. Oliver stopped teaching the enrichment curriculum. "I had a lot of bad feedback because I was trying to challenge them, and it upset the parents," Mrs. Oliver said rather bitterly.

> J H: Can you tell me about some other problems in their learning mathematics, like some problems related to their families or some support?
>
> Mrs. Oliver: In the beginning of the year, I told them this is an advanced math class. So, and I was pulling out of pre-algebra book to give them problems, you know, just extra (emphasizing) challenge in that class . . . . But the problem I have with that is that while I was trying to challenge them, and it upset the parents. They thought I was being too hard and too challenging. I got a lot of bad feedback. The principal and the office got the feedback.
>
> J H: By challenging them?

Mrs. Oliver: Sure. They are bright, bright, bright. They are making 99 on ITBS. They need to be challenged. ….

J H: I thought that parents may want to have more challenging work for their children, but it seems to be the opposite.

Mrs. Oliver: Yes, they want their children to have all As. It doesn't matter if it is easy, if they have all As. They don't want them to have hard stuff and get Bs, which is fine. They want all As. (First interview with Mrs. Oliver on February 16, 2001)

To the disappointment of many educators, today's dominating discourse in the area of education focuses heavily on the instrumental value of scores, grades, and school success. This discourse has spread across different groups of people, including policy makers, school administrators, parents, and even teachers. Any effort that questions the value of the instrumental value of learning (IVL) is seen as dangerous and, at best, useless. As a result, the genuine concerns for understanding and joy of intellectual pursuit, both from the educator and the educated, have disappeared somewhere. The domination of instrumental value of learning stifled all other types of possible educational discourses that focus on different values and potentials existing in education. Consequently, teachers, as well as others, have to take a serious risk, both personally and professionally, as they confront this problem, and challenge the currently dominating educational discourse in schools and society.

Mrs. Oliver wanted to confront this widespread tendency in schools and society based on her conviction that some students needed to be challenged more. She wanted to deliver a message that learning a higher level of mathematics was more important in their long-term academic pursuit than having a good grade right now. Yet, she ended up with a serious conflict with parents who "just want all A's" for their children no matter what their children actually could and would learn.

However, Mrs. Oliver herself was not immune from the IVL ideology, though she often resisted the extremes of such ideology trying to bring up some fundamental questions about

learning and education. Yet, she still tended to define her role in the context of schooling process, emphasizing the instrumental value of learning in students' lives. When asked the objective of her teaching, Mrs. Oliver firmly responded, "My objective is, I am telling each of my classes this is to prepare them for the next grade. My objective is to get them ready to succeed in the next classroom. And I feel like I am doing a good job."

Mrs. Oliver defined her role within the context of the formal educational system. This revealed her fundamental agreement with the instrumental value of learning throughout students' schooling process. She accepted that her primary responsibility was to prepare her children for the next grade and this was the very criterion she adopted to evaluate herself as a teacher. Mrs. Oliver paid little attention to the fundamental meanings of teaching and learning themselves. The short-term objective within the school system was enough for her to figure out what her responsibilities were and how she could fulfill those responsibilities well. Mrs. Oliver did not waste time as she was "teach [ing] from minute to minute." "I don't give them free days. I don't do videos and a lot of fluffs. I don't do a lot of fluffing classes simply because there is so much in math that they need to know for their next class." Mrs. Oliver repeated, "I know I am a good teacher."

Classroom Management

Classroom management was another big issue for Mrs. Oliver. "You cannot teach if you cannot control the class," she emphasized. "If you have a classroom in disarray, it doesn't matter how smart you are or what kinds of great ideas you have. If your classroom is not under control, you are not going to be able to teach anything." Mrs. Oliver made it very clear to her students what was expected of them in her mathematics class. Once students entered her classroom they automatically followed the rules established by the teacher from the very beginning of school year.

Since the very beginning of her career, Mrs. Oliver maintained a high level of confidence in her classroom management. "I've never, from the time I started teaching, had trouble with

classroom management. I don't know why." Then she said that her family experience growing up with two brothers and two sisters and being the oldest in her family might have helped her because she had to manage a home to some degree. Mrs. Oliver's way of classroom management was straightforward and authoritative. "I just try to go in and tell the class right at the start what I expect. And I just tell them that's the way it's going to be. And I try to let them know that I have a lot to teach them for their benefit. That I'm not teaching this for myself, I'm teaching it because they need to know it and I can't do it unless I can manage the class." She was firm in her convictions: "Then you know they respond. They just do real well. I give the expectations, and I say this is the way it's going to be, and they seem to not have a problem with it." Mrs. Oliver made it clear that her more personal relationships with students would have to be outside class time. "During my class time, that fifty minutes is fifty minutes of instruction, and we have got to get our instruction in." Mrs. Oliver presented her classroom as a public sphere geared toward one goal--effective teaching and learning--and presented herself as a strong authority in the space.

Ethic of Hard Work and School Success

Not surprisingly, Mrs. Oliver believed that hard work was the most important virtue in one's academic success and his or her future career. She was a strong believer in great effort. On the one hand, she heavily relied on test scores evaluating each student's potential or ability in mathematics. On the other hand, she supported the students who showed a great enthusiasm for learning, getting good grades, and school success. She felt obliged to provide special help to those students because they really wanted to do better. To the contrary, Mrs. Oliver was critical about students who seemed not to show any interest or enthusiasm toward their own learning. She expressed her disappointment and frustration about students who neglected their responsibilities as students. Once, she classified a student into this group, her instructional and emotional support for the student became rather limited. Mrs. Oliver was one of those teachers who embodied "the ethic of hard work" (see Appendix G for definition) of middle class society and expected students to practice the ideology in her classroom. One of Mrs. Oliver's success stories clearly revealed

her exceptional support for a student, Brittany, who "was such a hard worker." Mrs. Oliver recollected Brittany as a student who had highly respected the teacher's authority and eagerly followed the teacher's directions in her mathematics learning. Throughout the year, Mrs. Oliver provided Brittany with enrichment sheets, which were only used in her advanced math classes, and prepared her for an upcoming pre-algebra test. At last, Brittany passed the test and was placed in the pre-algebra class in seventh grade. Mrs. Oliver emphasized the importance of effort in Brittany's success in mathematics.

> J H: I would like to hear about your success story with a student or with a group of students.
>
> Mrs. Oliver: Let me think about a success story… She was in one of my regular classes. She was just a good (emphasized) student in there not because she was more intellectually gifted than anybody else. She wasn't in any special program. She was just a good average student. . . . . (omitted sentences) She was very attentive and often asked me questions. She would do just about anything that she was supposed to do though she was not super smart or had a good ability! She just worked at it. At the end of year we gave the placement test to see if they were qualified for pre-algebra. I only give that test to my first period and fourth period. So this little girl, Brittany, I could just tell that she was going to do well in math. So at the end of the year, I always gave her a challenge or two that I didn't give to the rest of the class. At the end of the year when I gave an assessment test to two other of my classes, I asked her if she would stay after school one day and take it. She was stunned with the suggestion. She would have done anything that I asked her to do. She was just real nice and, you know, it takes about an hour to take the test. She did so well on it and got placed in pre-algebra in seventh grade, then went on to be in algebra. And she is doing real well in high school algebra and high school math at this time. So, you know, she was just a regular student but I could see her potential in her. So, I just encouraged her and she was such a hard worker… I don't think it is anything I

actually did, except encourage her and help her... she needed to be in an advanced class because she could do it. And she did. She's great . . .” (First interview with Mrs. Oliver on February 16. 2001)

To the contrary, Mrs. Oliver expressed her uncomfortable feeling with students who had the ability and didn’t want to do anything. Joshua, in her second period regular class, was one of those students who often made Mrs. Oliver frustrated. Mrs. Oliver expressed her frustration toward Joshua who “doesn't even want to take the effort when he goes through the locker to get the right material and comes to the class.” His lazy attitude and delinquency were something she could never understand. In fact, students like Joshua often made Mrs. Oliver’s well-elaborated classroom management system impotent. Joshua did not care about the consequences of his inappropriate attitudes or behaviors in the classroom. He just ignored the symbolic meaning of various rewards and punishments existing in the space.

J H: Can you tell me about the next thing, a sad story in your teaching? You thought you had done your best but it didn’t work that well….

Mrs. Oliver: It's right here, Joshua. He is so bright. At the beginning of this year he would pay attention, he would listen and he would always have his work …. but I called him out twice last week because he has changed. He does not do his homework. He came in without his book today. He did not have a notebook. He comes in without his agenda. He comes in without a pencil. I sent him out to get it. So, I had to stop the lesson and go back. I told him in the hall, “Joshua, you have such potential. I think your mother knows that you can do better and I know you are a better math student. But you are not showing me. You are just not doing what you need to do here. I am going to expect you, starting today, to just start doing better and come in with your things. I know you can do this. It would make your mother happy. You know you would make me real pleased if you would at least try it. Put forth more effort.” Well, I felt good because I talked to him. Is he going to change? No, I knew he wasn’t going to change. The next day he came

> unprepared. I just didn't know what else to do to get him to do what he is capable of doing. He is passing but he could be learning so much more than [what] he is [doing now]. (First interview with Mrs. Oliver on February 16, 2001)

Mrs. Oliver believed that Joshua's mother did not handle her son's problem well enough. His mother seemed not punish him enough to make a significant change in his attitude. Mrs. Oliver said, "I think she is trying for a while right after I called her on the phone and talk to her. She will vocal down on him for a while and then she sort of eases off and he goes back." To Mrs. Oliver's point of view, Joshua needed constant discipline and rigid punishment at home so that he clearly understood the consequences of his laziness on his schoolwork. A stronger application of rules and regulations, along with more punishment, was her only resort with Joshua who did "not even want to take that effort."

Race, Class, and Gender Blind

In general, Mrs. Oliver's teaching philosophy and way of teaching mathematics could be summarized by two characteristics: ethic of hard work and justice principle (see Appendix G for definition). Mrs. Oliver believed that working hard was an essential part of school success, and that every student should embody or, at least, try to embody an ethic of hard work. Also, she believed that by establishing and following clear and objective classroom rules, she could make her classroom management as just as possible. In her classroom, students were viewed to have the fundamental responsibility for their own actions, and obliged to take the consequences of such actions: justice was expressed in two ways, rewards for rule-following behaviors and punishments for any violations of the rules.

Interestingly, these two characteristics seemed to be easily understood and accepted, even appreciated, by particular groups of students and their families—from White middle class backgrounds. To the contrary, students who came from rather marginalized ethnic and class backgrounds struggled more with these two ideologies. At the same time, Mrs. Oliver also struggled to understand students from other than White middle class backgrounds. She could not

fully understand the students and their families because they seemed not to practice the ethic of hard work, the prerequisite of school success in her thought. They looked that they did not appreciate the possible fruitions of academic success in their future careers. They did not seem interested in the education of their children because, in Mrs. Oliver's eyes, they did not closely monitor their children and were unable to re-direct their children in various situations. As a result, Mrs. Oliver negatively judged those students and turned the major responsibility over to their families when she witnessed a violation of school/classroom rules by those students.

At times very dedicated teachers do not understand the fact that some cultural and ethnic communities have difficulty in fully accepting the school success as understood by more privileged members of society. Mrs. Oliver was one of those teachers who had a very good understanding and worked extremely hard for her students' academic success, yet she had little understanding about cultural differences existing between her own White middle class community and others. Despite her strong and genuine desire to serve her students well, Mrs. Oliver had difficulty in understanding and acknowledging the reasons why some of her students were not as motivated as she expected, and why they sometimes resisted her approach to classroom management. Mrs. Oliver, like many other teachers at PCMS, thought that she needed to close her eyes to students' ethnicity, class, and gender so that she could ensure justice and fairness in her classroom. However, her blindness was the main thing that prevented her from reaching a better understanding of her students, particularly those from marginalized backgrounds.

The Mathematics Classroom

The Mathematics Classroom

Mrs. Oliver's classroom was located in "the upper hall" in which the majority of sixth and seventh grade students spent most of their time during the day. Her classroom was the second to last one to the left, not far from the exit door at the end of the hall. Mrs. Oliver's classroom was not much different from others in terms of its structure. It measured about 400 square feet with

one door connected to the hall and a large horizontal window on the other side of the classroom. The walls in the hall and classroom were all painted in two colors, dark blue and light blue. In the middle of the wall was a narrow white line dividing the two blue colors.

Mrs. Oliver's classroom has windows on both sidewalls, four small windows horizontally lined almost on top of the wall between the corridor and classroom, and a large horizontal window with eight glass panes on the other side. The large window was on the middle of the wall above the height of student's desks. Though I hardly saw the window open during the class, it transmitted all the bright things going on outside in the back yard of the school and street.

Physical environment. Mrs. Oliver's classroom was always neat and clean. Everything seemed to have its own place. To the left of the large blackboard and the large window was one computer with a printer. The computer was hardly used by the teacher or students. To the left of the blackboard was a bookcase filled with two different math textbooks and other enrichment resources and materials. On the corner of the wall were several boxes of instructional materials neatly stacked together. Mrs. Oliver's desk was located to the left of the bookcase hiding the stack of boxes behind it. Her plain office desk was made of wood. On her desk was a small three-layered tray where students put their finished worksheets. Beside the desk, was an agenda chart that students had to sign when they violated any rules in the classroom. To the left of Mrs. Oliver's desk were a dark green cabinet and a gray cabinet. The dark green one looked very old with several reddish stains and rust on it. Its doors would not close properly. The gray one looked relatively new compared to the other and its doors were always closed firmly.

In the back of the classroom was a sink in which Mrs. Oliver kept her instructional materials such as rulers, protractors, glue, scissors, worksheets, and other hands-on materials. They all had their own place and students knew they had to put them back to their original places once they were used. On the back wall were three posters about mathematics, one enlarged photo of a flower, emphasizing the mathematical arrangement of its numerous petals, and two others showing several geometric shapes and related formulas.

Impersonal and rule governing space. Outside Mrs. Oliver's classroom there is a sheet of paper hung beside the door: "Sixth Grade Rules: 1. Treat others, as you want to be treated. 2. Use time wisely. 3. Follow directions immediately. 4. Come to class on time, prepared. 5. Follow all the rules in the handbook." Passing through the door, you will find another notice titled, "Math Rules," on a small board attached on the back wall of the classroom. "Math Rules: 1. Pencil only. 2. Show your work. 3. Keep folder in order; 4. Write assignment in agenda book; 5. Get agenda signed every night." Her students also had a copy of the math rules as the first page in their notebooks. Also on the board were neatly posted school announcement sheets. The board also had three types of TOC (Table of Contents) sheets. One was for the first period which was an accelerated class, one was for the fourth period, an advanced math class, another for the rest of the classes, regular sixth grade math classes, covering the second, third, and seventh periods. Yet, the second period class moved slower than other "regular classes" because students struggled more with mathematics than their peers in other regular classes. Whenever the teacher gave students a sheet of paper, either as part of schoolwork or homework, she, or a student who volunteered, added the title of the sheet on their TOC table. Students checked on their TOC table from time to time. They knew they had to file everything recorded on the TOC table in their notebook for regular checkups scheduled every three weeks. Students also knew that the sum of TOC scores would become their grades in the end. The TOC table had about twenty rows and four columns; each row was for one assignment, and five columns were, respectively, for its number, date, title of the sheet, score received, and a little space for a parent's signature.

There was another chart students had to check everyday. It was a large laminated chart hung on the sidewall behind the teacher's desk. It had four large grids. The first grid was for the first period, the second grid was for the fourth period, the third grid was for the rest of the regular periods. The last column was left blank. Each grid had about three rows in it and each row specified today's activity, homework for today, and homework for the week. As a result, students

knew, to some extent, what they would learn for the day in their own class and also what other classes were learning.

In general, Mrs. Oliver's classroom reflected her conviction that strong discipline was essential in learning mathematics. She believed that effective classroom management was a prerequisite for any kind of learning to take place. She wanted her class to be "in order" and "under control." To that end, she made strict and detailed classroom rules in advance and delivered them to her students at the very beginning of the school year. As a result, her students knew what was expected from them and what the consequences of inappropriate behavior in the classroom would be. Jessica and other students remembered that Mrs. Oliver had been "kind of strict" from the first day of their sixth grade mathematics class. Although Jessica liked her teacher's firm attitude, Stella found it rather intimidating. Mrs. Oliver worked hard to make her students understand that her classroom was not a place for them "to play around." She had no doubt that her way of teaching mathematics, a strong disciplinarian approach, was most effective and even essential.

Mrs. Oliver's disciplinarian stance was also connected with the productive use of instructional time during her class: emphatically, she did not want to "waste time." When some students finished their work earlier than expected, she always had additional work on hand for them. She stated emphatically, "I teach from minute to minute. I don't give them free days. I don't do videos and a lot of fluffs. I don't do a lot of fluffing classes simply because there is so much in math that they need to know for their next class." She was punctual, accurate, and wanted to devote every single minute to instruction.

Mrs. Oliver presented herself as a strong disciplinarian who practiced rigid and impersonal rules and time management in her classroom. She believes that is the right way to teach students mathematics. To her, impersonalization of the learning environment and classroom instruction was almost inevitable to ensure effective learning. The human relationships she practiced during a lesson were formal, impersonal, and distant: She also expected students to be formal and polite in

her classroom. The following excerpt shows the impersonal characteristic of Mrs. Oliver's classroom in contrast to other teachers in the same hall.

> It was a chilly and cloudy morning. Walking through the hall, I saw a lot of Valentine decorations on the doors and windows in the sixth grade hall. On Mrs. Murphy's door was a large print, beyond this point, only positive attitudes are allowed." Around that were many cards mostly colored in pink and red with sweet descriptions, such as "I love Mrs. Murphy" or "Thank you for teaching us." I looked over the windows of Mrs. Thomson. There were a lot of hearts and other decoration using words like love, kind, nice, care, . . . etc. However, there was nothing on Mrs. Oliver's door and windows. No extra things for Valentine's day but the Sixth Grade Rules beside the door as usual. (Observation in sixth grade hall on February 21, 2001)

Communication of Images of Mathematics

As reported in the previous section, Mrs. Oliver displayed a rather limited understanding of mathematics and mathematical knowledge. She had a somewhat static and abstract image of mathematics, believing it to be an established set of knowledge with little flexibility or potential for change. It seemed hard for her to broaden her understanding of the possible uses of higher mathematical knowledge that had a direct or indirect impact on our everyday lives. Rather, she continued to emphasize the simple uses of four basic operations, addition, subtraction, multiplication, and division, as the representative examples of mathematical knowledge in our lives. Students' understanding of mathematics was not much different from Mrs. Oliver's. They believed mathematics was about "adding, subtracting, multiplying and dividing things," as well as "confusing," "really hard," and "complicated." April's response was typical among participants answering my question about what they thought about mathematics.

> J H: What comes up in your mind when you think of mathematics or when you hear the word mathematics?
>
> April: Numbers.

J H: Numbers. And what else?

April: You're adding, subtracting, multiplying and dividing things.

J H: Hmmm. Anything else?

April: … (Shook her head no.) (First interview with April on March 6, 2001)

Naturally, Mrs. Oliver's understanding of mathematical knowledge had a direct impact on her way of teaching mathematics. As reported in the previous section, Mrs. Oliver's understanding of knowledge and instruction reflected the 'nutritionist view of knowledge" and "depository" method in education. She perceived herself as a possessor of knowledge whose primary responsibility was to distribute appropriate pieces of knowledge to her students.

The most serious defect of this perspective is that it does not acknowledge that human knowledge, including mathematical knowledge, is a constructed one and that individual students are active agents creating their own meaningful set of knowledge through active interactions with others, such as their teachers and peers. In many cases, teachers having a static view of mathematics and the "transmission model of instruction," tend to emphasize mechanical memorization of facts, formulas, and procedures without paying enough attention to students' authentic understanding of underlying concepts. The use of various index cards in Mrs. Oliver's class clearly showed this pitfall. Her students made several index cards for each chapter filled with facts, formulas, shortcuts, and procedures they needed to remember. Some students, even the high achieving students, hardly understood what some of those formulas actually meant. For example, they had a formula, V=lwh (Volume =length × width × height) on their index card and used it as to solve any volume problems. In most cases, they did not have difficulty in calculating the volume of a cubic box by simply plugging the given three numbers into the formula. However, they were easily confused if the problem had excess information, such as the length of a diagonal. They were not sure if they also needed to use that information in calculating the volume. In the same vein, many failed to solve a problem that provided them with indirect information about the length and width of a cubic box. All they needed were three clear numbers

to plug into the formula. Since they were allowed to use their index cards during their chapter test, it was possible for them to get a relatively good score on it. However, they did not quite understand why a volume of a cubic box could be calculated by multiplying three given numbers, and there were many different ways to figure out the relevant information even though the question itself had no direct or sometimes, too much information in it. Amanda who tended to ask questions more often than others expressed her frustration about the formula.

J H: Tell me about the most difficult part that you learned during the last month.

Amanda: Hmmm (thinking). When we had to do the volume and the area. The volume is really hard to understand, like LWH. I couldn't remember all these things. The V equals something (and) A (area) equals something. It was just hard to understand. (Second interview with Amanda on April 30, 2001)

Students also possessed a traditional view of mathematics, static and immutable, with only one divine answer for a given question. Finding the "right answer" was the most important aspect of their mathematics learning. As a result, the logical process they had to follow through until they reached a conclusion had only partial value or instrumental value related to the ultimate goal of "finding the right answer." The following excerpt shows the moment when a student felt embarrassed or irritated when she found that a series of extra calculations led her to the same answer in the end. She expressed her disappointment that the extra time and effort required in the logical confirmation process was wasted, since it led to "nothing" different in terms of the answer.

> Students were working on several examples of simplified fractions. One student said that she had divided the denominator by the numerator and got the simplified fraction. The problem was 3/12 and she divided 12 by 3 and got ¼ as the answer. Mrs. Oliver said, "That's going to work occasionally, but in math it doesn't always work." She said they had to use GCF to find out if the fraction was completely simplified or not. She gave another example, 26/51 × 1/7= 26/357. She asked the students if the final fraction, 26/357

was a simplified fraction. Students kept silent for a while. Some said yes, but most students seemed to believe that it could be simplified to a fraction with somewhat smaller numbers. Mrs. Oliver initiated, "It is not easy to say whether this fraction is a simplified one or not. The best way to know it is checking out their GCFs. If there is a GCF between the denominator and numerator, we know we can simplify the fraction. Let's do that." She asked students a series of questions to find the GCFs for the denominator and numerator. In the end, she wrote 26/357=2×13/3×7×17 on the board. "Are there any common factors between them?" 'No!" students answered confidently this time. "So we know it is a simplified fraction." Then, several students looked frustrated finding out that they reached the same result after going through the long calculation process. One student said to the teacher in embarrassment and disappointment, "Then we did all this for nothing?" (Observation in advanced class on February 8, 2001)

Mathematics also meant "a lot of work," "complicated," and "long process" to students. Since students were mainly interested in getting the right answer, it was natural for them to "love shortcuts," which saved them time and effort. Students got excited when Mrs. Oliver started talking about shortcuts in class. Students paid little attention to the reasons why the shortcut worked. Learning "how" was so important to them that they had little curiosity about "why."

Way of Teaching and Learning

Mrs. Oliver's traditional view of mathematical knowledge had a direct impact on her ways of teaching mathematics. She was a very well prepared teacher who always took time to think through the flow of her lesson in advance and prepared everything before the class started. Usually, she adhered to a routine, beginning with a review of homework or a test, then proceeding through formal instruction to the entire class followed by individual work time. At the end of the class, the teacher and students checked answers together, and feedback was given as necessary. Her teaching was characterized by the following four characteristics: authoritative way

of teaching and learning, procedural approach, individualized work, and emphasis on speed and competition and their relationship with power issues.

Authoritative way of teaching and learning. Mrs. Oliver clearly represented herself as a mathematical authority in the classroom. It was quite natural for her to put herself into that position considering her epistemological belief about the nature of mathematical knowledge. She presumed that students did not have "something" that "they need [needed] to know." "I always know that I've got something . . . to show them," Mrs. Oliver said. The following excerpt shows how she responded to students who confessed their difficulty in learning fractions. She firmly and confidently stated, "Don't worry. I can teach you to do fractions." She represented herself as the main force and agency that would make the student learn and understand. The locus of control was on the teacher's side not the student's side. She presented herself as an active and authoritative knowledge possessor who controlled the outcome of learning, while at the same time the student turned into a passive knowledge receiver waiting for input from the authority and did not need to worry about her or his own learning.

> I had people before who said, "I can't do fractions" or "I had trouble with fractions." I was telling them, "Don't worry. I can teach you to do fractions." I know that I can teach them how to do fractions and the best way to do it. Once a student comes in and says, "I can't do this," it has challenged me because I know I can show them the way that they can do it. (First interview with Mrs. Oliver on February 16, 2001)

The authoritative characteristic of Mrs. Oliver's way of teaching mathematics was presented in numerous incidents that happened in the classroom. She often set up, as a mathematical authority, a clear limit for possible choices for the answer. The following excerpt is one example. The teacher set up a limit for their answers by saying, "You have only three choices here, 0, a half, or one in rounding fractions." Later, the teacher clarified where a half was located on the number line. Surprisingly, Jessica, one of the high-achieving girls in the class did not know where a half would be until the teacher marked it on the board.

> Mrs. Oliver was explaining rounding fractions, a new part recently added to the sixth grade mathematics curriculum. She drew a number line on the board and showed one example of rounding fractions with 7/8. Then, she started calling students to get more fractions as examples. The first student called on was Jessica, a White girl sitting in the second row. She gave the teacher 3/5. Mrs. Oliver asked the entire class what 3/5 would be after rounding. A boy in front shouted, "three!" Mrs. Oliver shook her head and firmly replied, "Nope. You have only three [two] choices here, zero . . . or one in rounding fractions. Three cannot be a choice." A few students simultaneously shouted different answers. Mrs. Oliver drew another line and divided it by five. She marked 3/5 on the line. "Is it close to half or one?" the teacher asked. After a short silence, Jennifer said, "I don't know because there is no point of a half (on the line). How can I know where a half is on that line?" Then, Mrs. Oliver divided the line by half and marked that point. "This is a half." Then, students were able to find the right answer. (Observation in advanced class on February 8, 2001)

Mrs. Oliver's students were deeply influenced from the authoritative culture of their mathematics classroom. We cannot assume that students' beliefs were only influenced by Mrs. Oliver's way of teaching mathematics. Students might have had many other teachers who practiced similar ways of teaching mathematics since first grade. The following two excerpts from Amanda's first and second interviews show a serious pitfall of authoritative way of this teaching mathematics. In the first excerpt, Amanda, a girl in the advanced class, said that she would rather give up her own way of understanding because the teacher's way was the best way to learn mathematics. Her statement was contradictory because she confessed that the teacher's way was sometimes confusing to her. Yet, she wanted to follow the "the way the teacher is teaching," rather than "a way that you know how to understand it." Following the mathematical authority was more important than acquiring an understanding in Amanda's world of mathematics learning. In the second excerpt, Amanda identified the reason why she thought she

had to follow the teacher's way rather than the way she could understand. The mathematical authority did not approve a different way of doing mathematics and, therefore, Amanda's own understanding was not important or valued in the space.

J H: What do you think is the best way to learn math?

Amanda: By the way the teacher is teaching you, but a way that you know how to understand it and that you can understand it.

J H: But, sometimes I believe … you found it was not easy to understand what she [teacher] was saying, right?

Amanda: Hmmm (yes). (First interview with Amanda on March 8, 2001)

J H: Tell me about the most difficult part that you learned during the last month.

Amanda: Hmmm (thinking). When we had to do volume and area. The volume is really hard to get, like LWH. I couldn't remember all these things. The V equals something. A (area) equals something. It was just hard to understand . . . .

J H: Have you ever thought about a better way to learn it? For example, I want my teacher to teach this content in a different way. In this way? Or in that way?

Amanda: Well, sometimes she just says, "Ok, this is how you're going to do this." When we tell her a different way, she's like, "April" …I told her (the teacher) that my aunt taught me differently. And Ms. Oliver said "Well, that's just my way. This is the way I'm going to teach it."

J H: So, um, tell me about that time when April was explaining another way to solve the problem. The teacher looked like she didn't like it?

Amanda: Hmmm (yes). …. She just said, "This is the way I'm doing it and this is the way you're going to learn it." (Second interview with Amanda on April 30)

Procedural way of teaching. Another important aspect of Mrs. Oliver's teaching can be termed as "procedural" approach. (Boaler, 1997, p. 107). Mrs. Oliver divided the entire process of

problem solving into several steps and constantly emphasized that students must follow those steps. She strongly believed that this "little by little" approach would help her students understand better. She thought that students failed to find the right answer because they did not carefully follow the procedure. Whenever a student came up with a wrong answer she repeated the sequence of those steps even when the student's problem was not related to whether she or he meticulously followed the right procedure or not.

> Mrs. Oliver started checking on the answers for five review questions from their previous lesson. Rachel was called to answer the third one. "It's 13/20." "13/20. And it is correct." Mrs. Oliver confirmed the answer and moved to the next one. "Benjamin, would you get the next one?" At that moment, Angie sitting in the second row rapidly interrupted. "Would you make it..." Angie quickly looked around others in the class and left the end of her question vague. She realized she was the only person who had a question about the previous answer. "Do you have a question for me?" Mrs. Oliver encouraged. Angie nodded. "You've got it wrong?" the teacher asked. Angie nodded again.…. Mrs. Oliver read out the previous problem. "9/10 - 1/4. Is this what you got wrong? I will look at it." She paused for a second. "If we have 9/10 -1/4, *what is the first step*?" "Set up the problem." Angie replied. "We set up problem ... You want to put this fraction here and you want to put this fraction here so we have two fractions to add." The teacher wrote the problem. *"What is step number two?"* "We want to find the common denominator," Angie said. "Yeah, We want to find the LCM. Using 10ths and 4ths, what's the LCM going to be?" "Twenty," Angie said. "Whitney, *What's step number three?"* Mrs. Oliver called on another girl who seemed not to have paid attention to her. Whitney slowly replied. "OK… In the third place, you use the LCM and know the denominator." *"What is step number four?"* The teacher asked again. Whitney could not answer this time. Mrs. Oliver demanded her to see her index card. "*Where is your index card? What is step number four?"* Whitney mumbled "Ah..." She opened her notebook and searched for

her index card. “Golden rule!” another boy sitting in the front row shouted. “Yes, you use the golden rule to get the numerator. …. “Five,” Angie finally said. “Yes, one times five is five.” “So what times 10 is 20?” “Two.” “So, 9 times two is 18.” *“What is your next step?”* “Here is the sign and we are going to subtract. 18-5 is what?” “18 -5 is... 8-5 is 3. And we bring down one here. So we have 13/20.” Mrs. Oliver finally ended her explanation for the question. “What did you get for this, Angie?” “I added,” Angie said. “You added it. OK. You have to watch the sign.” (emphases added) (Observation in regular class on February 23, 2001)

The pitfalls of procedural ways of teaching and learning have been reported in many previous studies (Boaler, 1997). Since students followed the process without a solid understanding of embedded concepts they often reported an awkward feeling about their own work. They blindly adhered to the rules without thinking through the process and understanding the reasons for each step. As a result, they felt insecure even when they actually got the right answer. They constantly looked for another person’s confirmation to ensure their work was on the right track. Stella, a high-achieving student in the advanced class, showed how fragile her confidence was though she got the right answer by following the steps. She confessed, “ I don’t know how I got this.” Another participant, Rose, also said, “I don’t know what she teaches but she teaches really good.” They did not have a larger picture or context in which they could draw some meaning or a deeper level of understanding about their procedural work. Rather, they blindly followed the given procedures having little chance to develop their own reasoning skills and reflective thoughts.

Brandy and Stella worked together this time too. Both worked on problems individually at first. As usual, Stella asked Brandy to help her out with one of the problems. She had already solved the problem and had the answer, which was correct. Yet, she was not sure if her answer was correct. She was anxious to get her answer checked by Brandy. Brandy was still working on previous problems. Brandy glanced at Stella’s sheet and said, “But

you did get this answer." Stella shrugged her shoulders and said, "But I don't know how I got this." "Waiting," Brandy said, and started working on the same problem. Stella watched Brandy's working process over her shoulder. (Observation in advanced class on February 8, 2001)

Another pitfall of the procedural way of teaching and learning was that students were unable to discern the conceptual meaning embedded in the process. Though they were extremely confident and quick once they took the first step, they found it very difficult to determine the type of mathematical operation required to begin the problem-solving process. Thus, they were constantly searching for an authority or clue to identify the relationships among the numbers and units presented in each problem. Once they knew the type of operation required, such as addition or multiplication, they rapidly followed the steps they had learned. However, they often did not know how to figure out the relationship in the first place. It was more like an enigma, remaining impossible to understand, sometimes even treacherous to them who were working so hard through the long and complicated process. The following excerpt shows the moments when students knew the process but did not understand the underlying concepts in changing different units.

> After the five-minute check was completed, Mrs. Oliver picked up the textbook and announced, "I need everybody's attention!" She had students open their textbooks and look at the rules for changing different units. She called on a few students to read each line. Then, she briefly reviewed the relationships among different units and how to convert one to another. "When you want to change a larger unit to a smaller one, you multiply this number. When you want to change a smaller one to a larger one, you've got to divide by this number. Do you understand?" She repeated this one more time by throwing two questions to the entire class. Students answered collectively as they had just read from the book. The teacher allowed students to work on the rest of problems in the textbook in pairs. … The next question seemed to be more confusing to April and

Christine. It was a problem to change 750 pounds to tons. They knew that one ton is 2000 pounds. Yet, they were not sure if they had to divide or multiply those two numbers. They tried both ways and then wrote 2 2/3 as their answer. They seemed to feel something was wrong with the answer. Since I was there with them, they asked me if their answer was correct. …. I asked them, "How many pounds will make one ton?" April said, "two thousand." "Two thousand." I repeated. April hesitated and then said, "(do we have to) have to multiply it?" She knew their answer was not right based on my attitude and wanted to take the other way that they had thought. I thought I needed to help them this time. "See, one ton is how many pounds?" "Two thousand," the two girls said looking a little embarrassed because they sensed that neither way they had thought was right. "Then you have only seven hundred and fifty pounds, right?" April said, "Is it less than one pound [ton]?" "Right, it's less than one ton. So, what should you do?" "You should subtract 2000 from 750." April said. "Think about that," I replied in disappointment. Christine suggested a completely different way of solving the problem, "2000 times 750, right?" "Well, one ton is more than seven hundred fifty pounds. Right? Because two thousand pounds makes only one ton. Now, you have only seven hundred and fifty pounds and it is going to be less than one. . . . What would you do?" "Subtract 750 from 2000?" They tried every possible operation with the two numbers. … But April soon said, "2000 divided by 750. . . " . . . . They did not understand what converting the units actually meant. They needed a conceptual understanding of such conversions, maybe with some visualization of different units and their relationships with each other. Yet this was not part of the instruction given to them today. At last, by trying all the different ways with the two numbers, April and Christine found that they could get a number less than 1 by dividing 750 by 2000. (Observation in advanced class on February 23, 2001)

Mrs. Oliver knew that her students had difficulty problem solving. She listened to students' "moan [ing] and groan [ing]" as she got into the problem solving part at the end of a chapter. "They close their minds to word problems. They don't want to read. They don't want to figure out what it is being asked," she deplored. However, she did not know what caused students' struggles with word problems. "I don't know," Mrs. Oliver honestly said. She conjectured a few possible reasons. "If they don't have enough background in it and it has been difficult maybe before, a lot of them have trouble in reading so that may be [they have problem] playing into it also." Mrs. Oliver concluded, "They have this problem and they have to read and figure out what 's going on. And it's just overwhelming…something instead of taking a little bit at a time." At this moment, Mrs. Oliver saw a glimpse of the truth: Word problems could be overwhelming to her students because it required "read [ing] and figur[ing] out what's going on … instead of taking a little bit at a time" as she taught in her classroom. Her step-by step approach, which she strongly believed a better and easier way for her students, actually made them struggle and frustrated with problem solving tasks.

She did not recognize that her procedural approach to teaching mathematics had, at least partly, a negative impact on students, especially their ability to tackle problem solving tasks. Students struggled to think through the conceptual relationships embedded in the processes they copied down on their index cards. This problem was often exacerbated as the teacher gave students a clue or starting point in the beginning of a mathematics problem and then re-emphasized the simple and mechanical calculation process after that point.

> They were learning ratio and rates today. . . . The next question they started working together was calculating the price for an apple when the price for 6 apples was two dollars. Dusty read the question and said, "Three dollars." The teacher said, "Who pays three dollars for an apple? I doubt it." Her face and voice surely showed that it didn't make sense at all. "How much is it per apple?" she asked students again. Students said different answers. Listening to all the different answers among them, students looked

> confused. Few students seemed to understand what the question required them to do. "How much per apple?" Mrs. Oliver asked a third time. . . . After responding to a few students' wrong answers, Mrs. Oliver realized that few students in the class actually understood the question. Students were confused between the number of apples per dollar and the actual price of an apple. She restated the question, clarifying that the condition was "2 dollars for 6 apples" and they had to find the price for one apple. . . . . Mrs. Oliver changed her question focusing on the number of apples for one dollar, "You get 6 apples for 2 dollars. So you can get" "3 apples!" shouted a few students. The teacher continued, "3 apples for one dollar, which is going to be one apple for a third of a dollar." "So, it's 75? 85 cents?" Rachel said loudly. Students became noisy again in order to give their answers. But Mrs. Oliver stopped students in a few seconds. "No! Stop, stop, stop, stop! Set up the ratio. Write it down and divide. You can either do it with 6 over 2 dollars or 200. You can do it 3 over 100. Divide it out. I will give you a minute to do that." Silence for a few minutes. "So what is it, Chris?" Mrs. Oliver asked. "33 cents," Chris said. "33 and 1/3 cents," the teacher corrected and then showed the calculation on the board. "You have one left over. You divide it by three. So it is 33 and 1/3 cents per one apple." She looked around the class. "That does make sense, doesn't it? One apple costs 33 1/3 cents." Students nodded in silence. (Observation in regular class on April 17, 2001)

The students' struggle with problem solving was an unsolved, and even disheartening, enigma to the teacher. Mrs. Oliver repeated, "I don't know why." She confessed, "I will tell you that problem solving with word problems is the hardest thing to teach." She was not aware of the fact that her procedural way of teaching was partly responsible for students' struggles, as well as lack of motivation, in problem solving.

Individual learning. The prevalence of individual work was another conspicuous characteristic in Mrs. Oliver's classroom. Throughout the entire course of this study, that lasted almost one semester, I observed only two group activities in her classes. Both were in the regular

class when students had some hands-on materials. One was with fraction pieces and the other was calculating the surface area of cubic boxes. I did not observe any group activity in the advanced class though I heard from my interviewees that they had played a group game, a competitive game, and received candies after that. Students in the two classes were accustomed to individual work. Though the majority of my interviewees said they preferred to work together their "working together" did not mean cooperative learning. Rather, it indicated that they worked individually and then checked on their answers together. Peer tutoring took place if their answers were not the same and one clearly knew that his or her answer was right. Though it was not genuine cooperative learning, students still liked it very much.

Surely, there was variation among students in their preference for pair or group work. Some students had a stronger desire for working together than others. Though Hannah, a gifted girl, did not prefer group work, Amanda did. Amanda abhorred long individual work that was an essential part of her mathematics class. She expressed her strong desire to work together with a partner or in a group. Usually, girls who had high anxiety preferred to work together because it relieved their feelings of insecurity in the classroom. These girls always thought about a possible failure or mistake that they might make. They longed for "a safety net" in case they fell off the high wire (Gilligan, 1993). Working together actually meant to them "a safety net." In the following excerpt, Amanda pictured such a moment of failure, in a very depressed tone, "It could be like ask[ing] you a question and you can't answer it." Her motivation was seriously damaged as she felt she

J H: In the math class?

Amanda: Hmmm.

J H: Do you think the teacher was not giving you any kind of help at the time?

Amanda: Hmmm. We just had to look in our book and then do it ourselves.

(Second interview with Amanda on April 30, 2001)

Competition, speed, and power relationships. Competition is a widely accepted cultural aspect of schools in the Untied States. Students know that their teachers evaluate their academic performances based on competitive criteria. Therefore, it is rather natural that students accept competition as a part of their schooling and became eager to apply those criteria to their friends. In this study, students constantly watched what everybody else was doing and compared themselves with others.

However, there was a variation among students in the levels of their conformist attitudes toward the competitive nature of schooling. Boys seemed to accept, even enjoy, competition as a natural process while girls tended to avoid the competitive aspect of their school experience. This tendency has been repeatedly documented in mathematics education literature (Boaler, 1997; Fennema & Peterson, 1987). Even among the girls, girls from a middle class background were more interested in comparing themselves with others than girls who came from lower class backgrounds. The following excerpt shows the moment when Heather, a middle class Caucasian girl in the regular class, closely monitored what others did and got, feeling uncomfortable and even frustrated, about her grades in mathematics.

> The teacher had students calculate their grades finding the mean of all their test scores for the last three weeks. Heather brought hers, which showed 98 as her mean. Mrs. Oliver shook her head and firmly said, "No, you've got 50, 60 here. No way." Mrs. Oliver sent her back to her seat and had her re-calculate the mean. Heather picked up a calculator from the back shelf and tried it again. After a while, Heather came up to the teacher again. She said in a low but definitely protesting voice, "Mrs. Oliver. But Celestina got 97, then I got 74." She looked very frustrated finding her score was much lower than Celestina's who she believed was at about the same level as herself. The teacher said, "That's not her grade. I will check on that later." Heather nodded. She seemed to be

satisfied with the teacher's response and went back to her desk. (Observation in regular class on March 13, 2001)

Speed was another interesting cultural characteristic observed in Mrs. Oliver's classroom. Speed is often understood as a sign of an individual's mathematical competence in school mathematics (Boaler, 1997). Though professional mathematicians hardly care about the speed of their mathematical endeavors, in school mathematics it is a different story. In Mrs. Oliver's classroom, speed reflected multiple social and cultural dimensions. It was apparent that overloaded curriculum demands and constant pressure from repeated standardized tests forced the teacher to emphasize speed in her lessons. For example, Mrs. Oliver had to squeeze three different learning activities into one class period and, as a result, students had to struggle trying to finish all the work within the limited time. The absolute lack of time available for rich, in-depth instruction was evident. This was, at least partly, why Mrs. Oliver used various strategies to press students to speed up with their work though she knew there was always "too much . . . to do."

On the other hand, students understood the power of speed and how it could help them look, and ultimately become, competent students in the subject. Students believed that students who finished their work earlier than others must be good mathematics students. Standardized tests that required students to finish more than thirty easy questions within a short period of time, also made students believe that speed was very important in mathematics learning. I often observed, particularly among boys, the students compete against one another to be the "first person" who finished the given assignment. They verbally expressed their satisfaction saying, "I am the first," or "I am done!" to others sitting around them. Even games that students played in the classroom often focused on the speed of simple calculations.

More interesting, speed in Mrs. Oliver's class was closely related to a privilege to monitor other students on behalf of the teacher. Students, particularly boys, were exhilarated to perform this role in the classroom. It was a chance for them to do various things that were ordinarily forbidden in the space: They could freely walk around the room. They could freely talk to others.

They could even interrupt other students' behavior, warning them to be quiet and making them stay in their seats. Students, particularly boys, often asked the teacher to give them the role when they finished their worksheet earlier than others. The following excerpt is one of such moments when two boys were in charge of checking other students' answers. To my surprise, Harry, a very quiet young man, presented himself as an authority while he was performing the role.

> Erik and Harry finished their worksheets first. They took their sheets to the teacher. The teacher looked over their sheets and corrected one answer. Erik asked the teacher if they could check on other students' answers while she was helping other students individually. She said, yes. Erik and Harry started to saunter around the classroom even though no students were raising their hands to check on their answers. They kept walking around looking at other students' worksheets over their shoulders. After a few minutes, they found that Catherine and Mandy stood up to walk to the teacher. They had just finished their worksheets and tried to take them to the teacher. Harry and Erik stopped them and made them return to their seats. They also snatched the girls' sheets and checked on their answers. Janet and Sydney also finished theirs and raised hands. Harry went to some other boys near the window and Erik came to Janet and Sydney. Janet found that she got everything right. She got excited and exclaimed, "Hey! I got everything!" Harry listened to this and came back to her. Then, he said seriously to Janet and Sydney, "Be quiet, guys!" (Observation in advanced class on March 7, 2001)

Discipline in The Classroom: Controlling Students' Minds and Bodies

Classroom management is an essential part of teachers' lives. Mrs. Oliver was one of the teachers at PCMS who had little problem with classroom management. She was very confident about her ability to get everything "under control." She believed that classroom management was the foundation of good teaching. "You cannot teach if you cannot control the class." She established a set of very explicit rules and procedures students had to follow in the classroom. She constantly and meticulously applied the rules with her students from the very beginning of

the year. Her classroom was also equipped with several visual aids that constantly reminded students of those rules and procedures. As a result, students were very well aware of the rules, as well as possible punishments and rewards if they violated or followed the rules. Her students knew that Mrs. Oliver was strict with those rules and there was little exception or consideration for them when they did not follow the rules. One of the punishments she used regularly was lunch detention. Every Wednesday, students who had not completed their homework or class work on time had to eat lunch in Mrs. Oliver's classroom and were not allowed to leave the room until they submitted their completed assignments. One of the students' favorite treats was a reward day held once each quarter. On that day, Mrs. Oliver allowed her students to play various math games and offered them snacks, such as cokes and cookies. Yet, she always remembered to post the "Reward Day Detention List" in advance. Students who had violated classroom rules more than ten times during the quarter were automatically excluded from the event.

Strong discipline in the beginning and end. Mrs. Oliver's class usually started with a close monitoring process in the beginning. The course of action that Mrs. Oliver most frequently took was having students put their homework on their desks, handing out their previous work that had been graded, or reminding them of some upcoming assignments and tests. Through these actions, Mrs. Oliver clearly presented herself as the authority in the space. She communicated explicitly to her students that it was her responsibility to monitor their behaviors closely, both in and out of the classroom, by checking their homework and grades. Her students also understood that she was strict, meticulous, and persistent -- in a word, extremely competent at her duties as she saw them. Any close monitoring will eventually find a violation, either major or minor, and this held true in Mrs. Oliver's classes. She always found at least a few violations or problems, such as a student's incomplete homework or making many mistakes on their previous test, in the very beginning of each lesson. Therefore, students started a lesson with a strong feeling of being monitored. She was very impersonal, even cold and distant, in applying a rule in any type of class rule violation. She was heavy-handed with her firm and strict principle, which had few excuses or

exceptions. The following excerpt pictures the typical starting scenes of a lesson when the teacher presented herself as the authority and monitor of the space.

> Mrs. Oliver had students display their homework on their desks. Students opened their notebooks, showing their homework sheets to the teacher. Mrs. Oliver walked around the classroom checking them out. She recorded in her log as she passed by each student's side. The classroom was extremely quiet. As usual, there were a few boys who had not finished their homework today. First, Mrs. Oliver stood by Jonathan's desk and firmly said, "This is not all you had to return. It's just part of your homework. Find the rest." Jonathan's face turned pale with surprise and fear. He did not say anything to the teacher. Instead, he instantly dropped his head and nervously turned over each page of his notebook to find the missing pieces. However, he could not find them in his notebook. Then, he pulled out all the sheets from his book and another yellow file. But the missing pieces were not there. Until this point, Mrs. Oliver was still standing beside him waiting for the missing piece while the entire class was looking at Jonathan in absolute silence. . . . As time passed, Jonathan became more desperate. He bent himself at his waist, almost crawling under his desk and chair and looked for the missing pieces. "These sheets should have been attached in your notebook." Mrs. Oliver pointed out several sheets now spread all over on his desk. "Ye. . . yes, Maam," said Jonathan squatting under his desk. His face almost broke into tears. "Go write your agenda, please," Mrs. Oliver commanded and walked to the next student. . . . After a few more minutes of fruitless effort Jonathan slowly stood up and walked to the teacher's desk. He wrote his agenda in the log. As he came back to his seat he burrowed his face in his arms and stayed still until the teacher's main instruction started. (Observation in regular class on February 6, 2001)

The last five minutes of Mrs. Oliver's class also had a strong emphasis on discipline. Mrs. Oliver often applied more stringent disciplinary codes for the last part of her class. Students were not allowed to leave her classroom until she named the group of students who could leave first on

that day. Her students stayed quiet looking at the teacher even after the school bell rang. They knew that the school bell was not enough: they needed a word from the teacher. The following excerpt shows the moment when Mrs. Oliver applied a stricter rule at the end of class. Students were absolutely quiet waiting for the teacher's final word. This was the routine repeated in the classroom every day.

> When I arrived in the sixth grade hall, Mrs. Oliver's classroom door was open as usual. It was very quiet, and I looked into the classroom. Students seemed to have already finished all their work. I saw only a few students walking to the teacher's desk to turn in their worksheets. All the other students sat quietly, looking at the teacher. They had already packed everything and were ready to leave the classroom. Several girls hugged their heavy math books and notebooks strapped together as if they were their teddy bears or pillows. Yet, they didn't move. Soon, the school bell rang, but the students in Mrs. Oliver's classroom stayed quietly in their seats. In contrast, students from other classes poured into the hall, creating a full minute of chaos as usual. April automatically entered Mrs. Oliver's classroom, then walked back into the hall looking embarrassed. I stood just beside the door and could see the expression on her face. "What's going on in there?" I asked. "They still have class," April said. Soon, Mrs. Oliver announced, "top lockers may leave." Half the students quickly came out. The rest followed shortly after. April and other second period students waited beside the door until the last student from the first period emerged. (Observation in the advanced class on February 20, 2001)

Automatic process. In Mrs. Oliver's classroom students did what they were supposed to do even without an explicit direction from the teacher. Students automatically started their work once the bell rang. They smoothly moved to the next activity as they finished the previous one. Whenever they violated a classroom rule, they automatically wrote their agenda in a log placed on the teacher's desk. Mrs. Oliver and her students referred to this action as "hit[ting] the agenda log" or "hit[ting] the chart." Students monitored their own behavior as well as others' based on

the rules and expectations given to them in the class. The following excerpt shows an example when students took an action without verbal instruction from the teacher. Students automatically "hit the chart" because they knew they had violated a rule in the class. During this excerpt the teacher only checked on student's homework. Yet, students who were ill prepared for class also reported themselves before the teacher took action.

> While students were busily working on today's five-minute check on the OHP screen, Mrs. Oliver walked around the classroom checking their homework. Even before she started with the first line, five students slowly stood up and walked to the teacher's desk to sign the chart. They hit the chart because they did not have their notebook, book, or pencil. Others who had not done their homework got a lunch detention from the teacher. The five students, Michael, David, Justin, Rachel, and Hannah, described why they hit the chart today, such as pencil, textbook, or being late for the class. Michael did not bring his agenda note and math book; David did not have a pencil; Justin had no textbook; and Rachel and Hannah had to go back to their lockers after class started. Rachel and Hannah left something in their lockers, possibly their homework or textbook. Later Mrs. Oliver explained to me, "This is a new one that they [we] just started. Since we planned a field trip, if they hit more than ten times, they can't go on the field trip." (Observation in regular class on March 1,2001)

Ethnicity, Class, and Gender in Classroom

Issues related to students' ethnicity, class, and gender were one of the most challenging aspects of this study. Mrs. Oliver hardly talked about ethnicity issues explicitly because it was a sensitive issue in the community. Pine County was a traditional southern rural county where the two major ethic communities, White community and African-American community, did not mix well with each other. Though about thirty percent of the entire student body was African-American students, PCMS had no African-American teacher except Mrs. Johnson, the librarian who had served there for more than twenty years.

Ethnicity in classroom. Table 4 represents the ethnic composition of Mrs. Oliver's four morning classes and three other classes, including one SWIS class, one Title I math class, and one special education math class. This shows that the percentage of minority students in regular classes and other remedial classes was much higher than the two advanced classes (see Table 4).

Students' seating in each class showed a more interesting pattern in terms of ethnicity and gender. Even though some changes occurred every day, there was a very clear pattern in students' seats throughout the semester. The following picture shows the typical patterns of students' seats in the advanced and regular classes. In the advanced class, high achieving Caucasian boys and girls usually took seats in the first and second rows (see Figure 1). Two African-American girls, Stella and Brandy, always sat in back seats near the exit door. Tanya, who used to sit in the first row in the beginning of semester, moved to a back seat behind some struggling Caucasian girls. While she was sitting in front she tended to work alone even when the teacher allowed students to

Table 4

Percent of Minority Students in Seven Sixth Grade Mathematics Classes

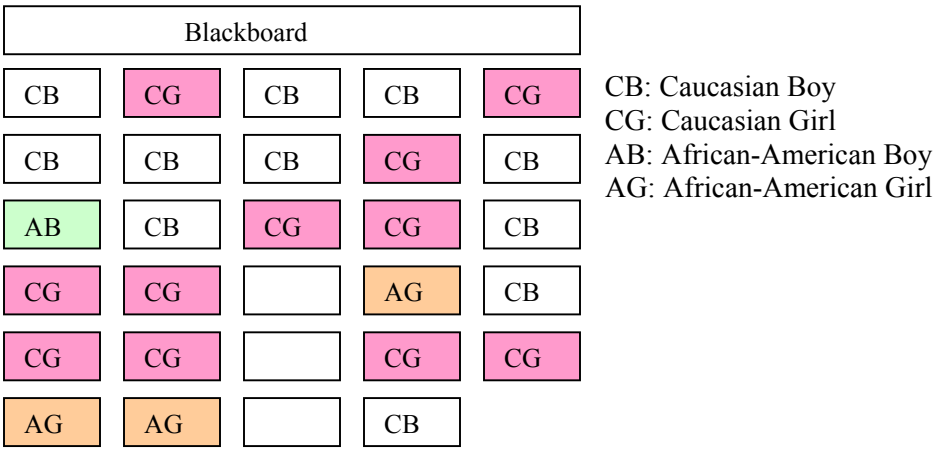
Period	Cauc-asian Boys	Cauc-asian Girls	African-American Boys	African-American Girls	Hispanic Girls	Total	% of Minority Students
1(Advanced)	10	12	1	0	0	23	4%
2(Regular)	10	5	2	1	1	19	21%
3(Regular)	10	5	2	2	0	19	21%
4(Advanced)	11	11	1	3	0	26	15%
SWIS Class	5	2	3	5	0	15	53%
Title Math	3	2	1	1	0	7	28%
Special Class	7	1	1	1	0	10	20%

work together. It was not because she liked working alone. There was no person who eagerly volunteered to be her partner during group or pair work time.

Mrs. Oliver's 2nd period had a unique characteristic. This was the lowest level class among her three regular math classes. However, there were still many Caucasian boys and girls from middle and upper middle class backgrounds. Even though Mrs. Oliver did not know much about the detailed socioeconomic status of each student's family, she knew there were disproportionately many students in this class who had a higher SES background. Later, I found some students in this class had been placed in SWIS class based on their initial scores on ITBS test, yet their parents wanted them to be in "a regular class" which the school arranged. Mrs. Oliver could identify at least several students in the class who came from "upper middle class" backgrounds. Those students usually sat in the first two rows in the class, except Celestina, a Hispanic girl, who had high anxiety in mathematics and wanted to move down to a remedial class for the next year.

Ethnicity and class. The majority of minority students in Mrs. Oliver's classes had difficulty in relating to the teacher. On the other hand, Mrs. Oliver also struggled to understand most of her minority students. She tended to show a stricter attitude toward minority students because she felt they did not put enough effort into their schoolwork. Even Amanda, a Caucasian girl, felt that the teacher treated Stella, an African-American girl in the advanced class, differently

Figure 1. Seat arrangement in advanced class, April 27, 2001.

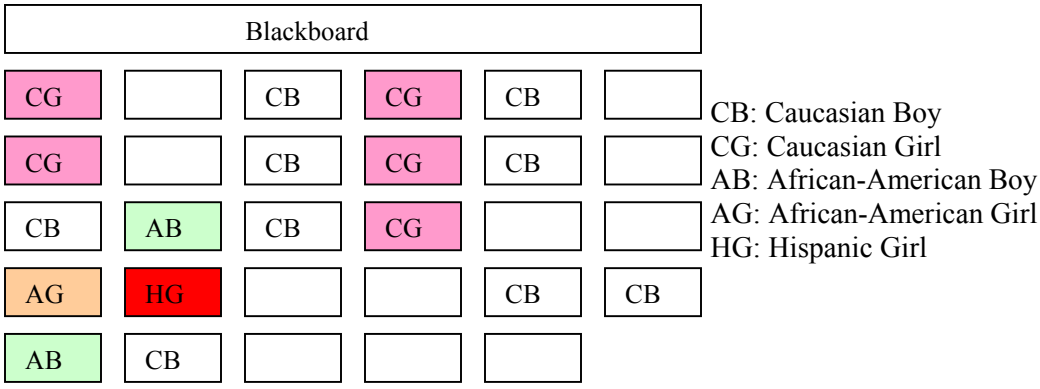


from an equally smart Caucasian girl. Basically, Amanda believed that Mrs. Oliver favored "smart children" over other students.

Responding to my question, Amanda enumerated the names of smart children in the advanced class, which included Stella and Jessica. Ironically, she realized that Stella was not allowed the same privileges that smart White girls enjoyed in the classroom. "I don't think that's fair because Stella, she's really good in the class," Amanda said.

> J H: (after Amanda mentioned that the teacher treated students differently) Then tell me a little bit more about how she is treating her students differently.
>
> Amanda: She like um . . . . (paused for a while) smarter children, all right, Stella, Sidney, and Jessica. She does not let us (students other than the "smart children," to use Amanda's terminology) go to the restroom at all. And if you (indicating a student other than the "smart children") ask to go to the restroom, she'll say, "No, you should have gone earlier. But if they ("smart children") go ask her, she'll say yeah.
>
> J H: Can you remember a time when that kind of thing really happened?
>
> Amanda: Stella. She went to ask to go to the restroom and then Mrs. Oliver said, "You should have gone earlier", and then um, Jessica went to ask her if she could go to the restroom and Mrs. Oliver let her. I don't think that's fair. Because Stella, she's really good in the class.

Figure 2. Seat arrangement in regular class on February 27, 2001.



More interesting, Stella herself felt that Mrs. Oliver was treating her differently, considerably better than her African-American friends. Responding to my question about whether her teacher would offer her extra help, Stella separated herself from her African-American friends, emphasizing that the teacher would do so. “She would help me,” said Stella. She tended to compare her treatment by the teacher with that given to her African-American friends, and believed that Mrs. Oliver showed her more kindness and support. Clearly, she reacted to this fact with relief and satisfaction. Even though Amanda thought that Stella, as one of the smart children in the class, deserved the same privileges that other Caucasian girls enjoyed, Stella herself did not share this feeling. She avoided comparing Mrs. Oliver's treatment of her with the way she treated high-achieving Caucasian girls. This was something she simply did not do.

Mrs. Oliver had very little communication with the African-American community in Pine County. She had little chance to meet the parents of her African-American students and found it difficult to understand their perceptions and difficulties with schooling. She did not know what helped Stella become such good student. “I don't know her parents or why she's so motivated, but she has always done real well in school,” said Mrs. Oliver. Regarding another African-American student, Rachel, Mrs. Oliver stated, “I do not know her parents. I've never had any conferences with them or any occasion to have to call them because of her behavior or anything. So just by progress reports and agendas, I've communicated with her parents . . . . so I don't know her mother.”

However, Mrs. Oliver’s relationships with other Caucasian parents were different. With Jessica’s mother, she had a very positive relationship. “Jessica's mother is a professional and I don't know her father. But they support her in her education. They communicate with me to see how she's doing. And they expect Jessica to do well.” Mrs. Oliver also had a good impression about the family of another middle class Caucasian girl, Heather, who was struggling with mathematics in the regular mathematics class.

> Yeah, because her mom and dad are real supportive. I saw them at the ball game one night this week and they were very friendly and very nice. They asked how Heather was doing. Heather told me that her parents are going to send her to a different school next year unless she brings her grades up. And Heather, you know, she's, if she pays attention, she just amazes me sometimes. She does so well. …. [She] just makes so many careless mistakes [because] she just flies through it. But her parents also are real supportive. And they want her to go to college. (Second interview with Mrs. Oliver on April 19, 2001)

Mrs. Oliver's perception of students' potential in mathematics was deeply related to her perception of family support available to each student. When she perceived a student had strong family support she tended to overestimate her or his potential regardless of her or his current achievement level. Mrs. Oliver's perception of the availability of a family's academic support was largely influenced by each family's socioeconomic status and the educational level of their parents. Since there were only a few highly educated African-American people holding professional jobs in the county, Mrs. Oliver's perception of students' academic potential was often bounded with students' ethnicity. In the same vein, she underestimated the potential of other Caucasian students who came from working class backgrounds. Amanda, Rose, and sometimes, April were those cases.

> Amanda struggles in math. I don't think that … Her mother has been up here, I've met with her mother several times, but she doesn't get the support at home where they talk about the importance of school. It's just get your homework done [and] go on and do it. But I don't think she gets [that] it's important because next year you're going to build on this. Her mother wants her to do well, but again, I don't think that she's had that experience of how important it is. I'm not sure how far her mother went in school. (Third interview with Mrs. Oliver on April 26, 2001)

Mrs. Oliver expected much less for Amanda, who had been a "all A student" in elementary school and scored more than 85 on the entry test to come into the advanced math class, than

Heather who barely met the criteria to be in the regular math class and was still struggling with what she was learning there. “I see that she's [Amanda] going to probably struggle.” “She'll probably get a job at Wal-Mart or somewhere like that.” It was just overwhelming and even painful to see the impact of family’s SES status on the teacher’s perception of students’ potential in mathematics and in their future careers.

Gender in play. Mrs. Oliver did not like gender research in mathematics education. What media reported about gender differences in students’ mathematics achievement seemed to be very different from her own experience with male and female students.

> J H: Do you find any difference between male students and female students?
>
> Mrs. Oliver: Usually. . . (paused) usually it seems that female students are much more motivated. They are much more concerned about, you know, asking questions and understanding what was[is] going on. So you know, any time I hear someone say, they are trying to get female students to do better in math, I don't know what . . .(paused) how math becomes easier for boys. Is [it] just natural? But you know a lot of my girls in here they are my best math students. (First interview with Mrs. Oliver on February 16, 2001)

However, soon, Mrs. Oliver shared another experience, which reflected what Leder (1992) and Li (1999) said in the literature: different attributions for boys’ and girls’ success in mathematics.

> I will say they [girls] are more motivated and they want to do better. Yes. But sometimes, I will see some boys, I know they haven't being paying attention and they would come up and get everything. They just had it. I don't know how I have to answer that or how to say why that they are just more comfortable with math sometimes, but I do see it occasionally. Sometimes, boys are more comfortable with math. I don't know why. But girls are much more motivated for what I have seen. They have their homework a lot more than boys do. I don't know why. (First interview with Mrs. Oliver on February 16, 2001)

Even though Mrs. Oliver wanted to be gender blind in her class to ensure equal treatment to all of her students, boys' loud voices and gestures often affected girls' opportunity to speak in public. The following excerpt shows one such instance from my observation log.

> Mrs. Oliver checked answers for the questions that students had worked on with their partners. . . . . (omitted sentences) When it came to No. 37, a critical thinking question, students shouted different answers. The teacher drew a clock on the board to facilitate students' thinking. (The question was to measure the angle between the starting point (12) and the point where the minute hand of a clock indicated exactly five minutes). Justin, who was sitting in the second row near the window jumped to the blackboard to show his answer on the board. The teacher said, "No." Jason and Tyler, and several boys shouted their answers loudly. Actually, they seemed not to know the answer very well, but they actively asserted their answers were correct. Girls, including Ginny and Beate, raised their hands quietly. Yet, they did not get a chance to say their answers. The boys were too loud. In the end, the teacher found that students, mostly boys were not able to give her the correct answer. Realizing there was not much time left, the teacher gave the answer. Then, a few girls put down their hands without saying anything. Most girls, who raised their hand at first, did not persist up to this point. They had already given up. (Observation in advanced class on March 1, 2001)

Two Worlds in Operation

Throughout my study, I observed that Mrs. Oliver created or managed two different worlds at PCMS: One, a public world; the other, private. She was a person who practiced a clearer separation between the two worlds than other teachers in the sixth grade hall. She practiced different ideologies and self-identities in the two spheres and her relationships with students also changed as she moved back and forth between the two worlds.

In the public sphere, she valued the "justice principle," (see Appendix G for definition) which emphasized her role as an authoritative commander, objective evaluator, and impartial

judge. Her justice principle focused on the equal and impartial, sometime blind, treatment of students solely based on their behavior. It required her students to be aware of and accept the positive and negative consequences of their action in her classroom. Mrs. Oliver believed that being a strict mathematics teacher was important, even essential, to make her students motivated to learn. She established strict classroom rules and a disciplinary system in the beginning of the year and made them clear to her students. She held high expectations for her students both in their behavior and academic performance. When a student did not meet her expectations, Mrs. Oliver strictly applied the established rules to the student. She wanted to make all these processes objective and fair as well as consistent. For this reason, she kept detailed records about students' homework, grades, preparedness for class, and classroom behavior. Students felt she was one of those teachers who might know everything they did, good or bad. They believed they could not escape from her web of monitoring in her mathematics class. The most typical moments in this world of justice in active operation were when Mrs. Oliver started and ended a lesson as well as when she was engaged in a rather formal lecture style instruction during the class.

> Mrs. Oliver opened her textbook and had Betty read a question from the book. It was a problem-solving question. "What is this question asking for?" Mrs. Oliver asked to the entire class. At that moment, she noticed that Joshua was saying something to Doug. Mrs. Oliver rapidly said, "Joshua, hit the chart." "I was . . . . (paused)" Joshua tried to explain something with a protesting gesture. Doug seemed to have made Joshua say something and Joshua wanted to prove his innocence in the situation. But it was in the very middle of instruction. The teacher did not want to give him a chance. Quickly, quietly, but firmly the teacher repeated, "Hit the chart." Joshua's face spontaneously distorted in frustration. Yet, he soon realized there would be no chance for him. He irritatedly shook his head but slowly walked to the teacher's desk to hit the agenda log. On the way back to his seat he looked angrily at Doug. Doug did not dare to meet Joshua's eyes and kept

his head dropped down close to his desk. He said nothing for a while. Neither did Joshua. (Observation in advanced class on February 8, 2001)

On the other hand, Mrs. Oliver operated another world, completely different from the public sphere. This was a private world in which she showed the gentle side of her personality and professionalism to students who, she believed, needed such support and encouragement. She followed "an ethic of care," (see Appendix G for definition) rather than the "justice principle," to relate herself with students coming into her private world. In this world, Mrs. Oliver showed great compassion and understanding of an individual's situation, and provided students with her special and genuine support and care. Sometimes, she did not even mind taking a risk that would cause a problem to the order of her public world if she strongly felt that a student needed her special support. She eagerly and happily sacrificed her personal time to help students in this world of care. Mrs. Oliver often created this private world when she was engaged in a personal or one to one conversation with a student or with a small group of students. She also readily created this world and caring relationship when she perceived the student was under difficult circumstances imposed by outside factors.

When Mrs. Oliver judged that the student did not have any control over the situation but had to go through or live with the undesirable condition, she walked out of the public sphere and created a private sphere for the student. For example, Mrs. Oliver regularly took her lunchtime to help a girl who "broke into tears" during a test. The girl desperately wanted to meet her family's high expectations and Mrs. Oliver decided to help her because she "want[ed] to do well. . . . . And that's important." In the same vein, Mrs. Oliver showed exceptional care and support for a newly-transferred African-American girl because she found that "she [new student] did not learn anything about fractions" in her previous school and needed extra help from her.

In most cases, Mrs. Oliver's two worlds were quite separate from each other in terms of when, where, and with whom they were in active operation. The existence and operation of such different worlds had two contrasting meanings to her students. Mrs. Oliver tried to effectively use

the two worlds, along with the contrasting operating principles and the modes of her relationship with students in those worlds, to ensure the most beneficial outcomes for her students. However, there was a serious problem in her operation of those two worlds within the school context: Not every student was able to walk into the private sphere unless Mrs. Oliver allowed her or him to do so. Mrs. Oliver was the strict gatekeeper as well as the caring and loving resident living in the world of caring. She tended to allow students to come into the private sphere when she perceived that they had no control over their problem, or at least that they had done their best to deal with the problem. Mrs. Oliver's understanding of their situations and positive evaluation of those circumstances were essential for any student to come into the private sphere. In the following excerpt is an example that shows Mrs. Oliver's contrasting perceptions and attitudes toward two different students. When she perceived Justin and David had trouble with a math problem she was willing to explain it again. Yet, she clearly rejected Elmer's request based upon the justice principle.

> Mrs. Oliver checked on the next answer. She asked if anybody missed the question. "Anybody miss it?" She looked around the class. Justin and David were talking with each other looking at their sheets. The teacher thought they must have missed the question. "Hey, look at here." Mrs. Oliver said, picking up another chalk. Justin quickly said that they had not missed the question. "You didn't miss it?" asked the teacher and the two boys said, "We got it." Then, Elmer said that he did not get it. Mrs. Oliver paused a second and said, "I will not give you help because you missed everything yesterday. You didn't use your index card at all. You sat over there and did the same thing you are doing now. You don't hear anyone laughing, do you? You didn't get your work done yesterday. So, I don't want to help you today. OK?" Elmer knitted his brow for a few seconds and then remained in an "I don't care either" attitude. Mrs. Oliver indifferently went onto the next question. … When she finished all five questions she asked, "Who got all five questions?" Several students proudly raised their hands. "Several of you did. Very

good," Mrs. Oliver complimented them. (Observation in regular class on February 23, 2001)

Unfortunately, teachers' understanding of students' difficulties and problems is often limited by teachers' own cultural, socioeconomic, or religious experiences. The extent that teachers understand or feel compassion for their students naturally differs based on the teachers' prior experiences and cultural values. It is difficult for anybody to overcome this limitation. Mrs. Oliver was no exception. Though she tried to maintain her objectivity in interpreting each situation, and deciding what kind of world she would put in operation in each moment, she tended to be more generous to students who came from White middle class backgrounds. She had little doubt about the legitimacy and fairness of school practices. In her view, any sensible person should understand and appreciate the importance of schoolwork, and everyone needed to work hard in order to derive maximum benefits from his or her education. Her disapproval of students who did not accept the "fair school ideology" and did not embody the "ethic of hard work" in their lives was so strong that these students were hardly able to come into her private world to receive her special support and care.

As a result, minority and working class students who were having trouble in the classroom and at the school were least likely to enter her world of caring. They did not have much chance to receive the teacher's special care and support that they needed, maybe more than other students. What they lived in all year long was the public world, filled with rigid rules and regulations, often impersonal, distant, and cold. From time to time these students observed the moments when the teacher acted differently with other students and felt hurt. To them, "smart children" seemed to enjoy illegitimate privileges that were never available to them in the same space. Even though Mrs. Oliver believed that creating and maintaining her public world was more effective in helping those troubled students work and learn, the very students felt a deep alienation from Mrs. Oliver's class. They felt they were being forced to live in a world that was extremely scary and unpleasant to them. This experience somehow reinforced in their minds negative and cold images of

mathematics learning. As they transmitted the cold and impersonal images of their mathematics classroom into mathematical knowledge, they also transmitted their frustration and anger. From their perspective, their mathematics classroom was a hostile place in which they little felt warmth and care from the teacher or the "geeky" "smart children" sitting beside them. It seemed logical to them that mathematics learning was by nature an unpleasant, frightening, and alienating experience.

Summary

Pine County, a rural county located in the Southeast, was a place of residence for two major ethnic communities, White and African-American. The two communities maintained fairly separate ways of living from each other in terms of their income level, residential area, church affiliation, and education. During the past several years, Pine County experienced a slow but steady influx of White professionals from outside the area. This resulted in a significant growth of the White community, and widened the economic disparity between the two communities.

Students at Pine County Middle School (PCMS) reflected the economic disparity between the two ethnic groups. Minority students tended to live below the poverty level three times more frequently than White students, and the African-Americans and a small number of Hispanics among them were disproportionately assigned to lower level mathematics classes, such as SWIS and Title I. Newly hired and less experienced teachers tended to teach those classes, often against their preferences. In addition, the student population included a significant number of White students from working- or under-class backgrounds.

Teachers at PCMS, despite their desire to serve all students, suffered from a lack of understanding of the students who came from other than White middle-class backgrounds. The school's teaching force was entirely White, with no minority teachers. White middle-class students and parents dominated most school functions and selective clubs supported by the school administration. Newly transferred students and newly hired teachers felt that the diversity of the PCMS student population was not appreciated as much as it deserved to be. The school

administration and the majority of teachers had difficulty learning to better understand students and families from other than White middle class backgrounds, their families, and communities. It seemed hard for them to celebrate minority students' differences in the face of pressure from the increasing number of White middle-class parents who influenced many decision-making processes at the school.

Mrs. Oliver was a confident, hard-working, and well-respected mathematics teacher at PCMS. She communicated great enthusiasm for teaching and longed to serve her students. Yet, her professional journey reflected some problems and difficulties inherent in teacher education. She started teaching sixth grade mathematics not out of personal preference but because of the chronic shortage of qualified middle school mathematics teachers in the state. Significantly, her professional development was relatively isolated from professional communities of mathematics teachers and researchers. Though she continued to expand her mathematical knowledge and teaching skills, she continued to hold a rather static view of mathematics. This affected her approach to teaching, causing her to adopt a more traditional mode of instruction: authoritative, procedural, and individual.

During the last several years, Mrs. Oliver found herself struggling under various pressures from outside. She resisted the accountability discourse and blind use of standardized tests in evaluating students' academic potentials. In some instances, she opposed the predominance of the instrumental value of learning. She believed that the ultimate goal of teaching was not to give students the best grades, but to provide them with a chance to expand their intellectual capacities.

Mrs. Oliver believed that the ethic of hard work was more important than "having the ability." She eagerly committed herself to the students who were concerned about their academic performance and willing to work hard. In contrast, she had difficulty understanding students who seemed not to accept the fair school ideology and did not embody the ethic of hard work. Her disapproval of those students was so strong that it prevented her from establishing a more personal and supportive relationship with them. Rather, she applied strict classroom rules to

control their behavior, thereby creating a clear distance between herself and the non-conforming students.

Unfortunately, Mrs. Oliver did not grasp the fact that ethnicity and class background heavily influenced her perception of and relationship with each of these students. Her deeply held beliefs in hard work essentially mediated these relationships. Since she assumed that all students should believe that school and teachers were fair and schoolwork was critical to their future success, it was hard for her to understand the ethnic minority and working-class students who seemed not to share this point of view. She did not recognize that those students' experiences with school might have been very different from those of more privileged members of society.

In her mathematics classroom, Mrs. Oliver established two different worlds, consisting of the justice principle and the ethic of caring, which she believed would most effectively help her students work and learn. The numerous rules and behavioral codes established in the very beginning of the year reflected the world of the justice principle. Students were expected to have formal and distant relationships with the teacher in strict accordance with the rules. The other world consisted of the ethic of caring, in which the teacher's special support and warm encouragement were available and extended as needed.

Unfortunately, Mrs. Oliver's world of caring was not as readily available to some students as it was to others. Those who seemed to embody the ethic of hard work easily entered, enjoying the teacher's special support and care. Most of them were from White middle-class backgrounds. In contrast, ethnic minority and working-class students tended to live in the world of the justice principle throughout the year. As a result, they experienced school mathematics as a cold, distant, boring, humiliating, and frightening discipline in which they rarely felt valued and cared for.

CHAPTER 6

FINDINGS: STUDENTS

The participants in this study showed a great variation in their experiences and perceptions of school mathematics. This does not mean that there was absolutely no commonality in the girls' experiences with the same mathematics teacher in the mutually shared school environment. Surely, there were some commonalities among the participants' experiences. For example, all participants reported some degree of anxiety about learning school mathematics. All of them wanted to be good students, even though their notions of what a good student was and how to become one differed somewhat from each other's and from the teacher's. More interesting, however, each participant's experiences and perceptions of school mathematics were dramatically different from each other depending on her ethnicity, SES background, class level, her current and previous math achievement, and the teacher-parent relationship. For example, there was a huge difference between the experiences of Jessica, who came from a White middle class family, and those of others who came from more marginalized backgrounds in terms of their ethnicity and class. I will present five participants among seven girls who took part in my study. I did not include two of my participants, Heather and April, because their data indicated profiles similar to those of Celestina and Jessica respectively.

The following five cases, profiles of Jessica, Stella, Celestina, Rachel, and Amanda, reveal the profound impact of ethnicity and class upon their experiences and motivations. In addition, each case illuminates the unique interrelationships and dynamics among the various cultural ideologies they were exposed to, subscribed to, elaborated on, expanded, or resisted in their everyday lives. Girls in this study were not mere scapegoats of negative or unfavorable social influences from outside but active agents who voluntarily chose an ideology that seemed to best

benefit themselves. Their multi-layered, sometimes contradictory, voices reflected their deeply embedded desires and hopes as well as their ongoing struggles to move toward a possible model of learning mathematics that had not yet been actualized in their realities.

Jessica: The Successful Student

Jessica, a high achieving Caucasian girl in the advanced mathematics class, was the first student I invited to participate in my study. From the very beginning of my classroom observation, she clearly stood out among the twenty-three boys and girls in Mrs. Oliver's classroom. As expected, Jessica was a perfect little collaborator throughout the project. She showed a high and steady interest in my study and eagerly spent time reviewing her own transcripts in order to give me feedback; e.g., "I found that (transcript) you put a different name for my teacher and my brother." Also, she never hesitated to ask me questions.

Jessica was a little over five feet tall, a medium height among sixth graders. She had shoulder-length blond hair, neatly cut, which she often wore in ponytail secured with a hair-tie or a hairpin. She always sat in the same seat, the center one in the second row, surrounded by her friends, Mariana and Kathleen. She was extremely attentive throughout Mrs. Oliver's class, seldom engaging in private conversation with her friends unless it was time to check each other's answers. She always came to class on time, hugging her math book and math notebook, which were neatly bound with a red and blue elastic strap.

Jessica's family was middle class. Both her parents held professional jobs and owned a large house between Pine County and Apple City. She had one "naughty" younger brother, David, in second grade. Jessica's parents had high expectations of their daughter's education. Her mother carefully checked on the streaming level in which Jessica was placed and on her progress in class. Both parents maintained open communication with Mrs. Oliver, which reinforced Jessica's confidence in mathematics and her positive attitude toward her teacher.

Loving Strict: Cultural Cohesion Between Home and School

Jessica was a typical example of a girl who achieved in mathematics. Her motivation and identity in the domain were firm and strong, and her social world, family and friends, helped her accommodate herself to the somewhat cold and impersonal culture of school mathematics in various ways. Jessica explained her comfort with a strict mathematics teacher by revealing her previous experience with her parents. She described them as "loving strict," and she appreciated a strict teacher with a similar approach. To Jessica a strict teacher meant a responsible and loving teacher who made sure that his or her students learned. For this reason, she easily identified herself with Mrs. Oliver, her strict mathematics teacher.

J H: When you first met your math teacher, how did you feel at first?

Jessica: I kind of like strict teachers, so when the first day of school she was kind of strict, I said, "Ooo, I think I'm going to like her."

J H: Mmhm. So you are keeping the same kind of feeling about her until now, right?

Jessica: Mmhm (yes). (First interview with Jessica on March 9, 2001)

In her third interview, Jessica also expressed her excitement about having another "tough" mathematics teacher in seventh grade. She said, "I've just heard that she's really tough in math. And I'm kind of excited because I kind of like a little bit of a tough teacher." Again, Jessica referred to her father as an influential figure here. "When I tell my mom that Mrs. Oliver is my favorite teacher and I like her because she's kind of tough and she's organized, she (mom) says, 'you're just like your daddy because he likes people that are organized and people that are kind of strict and tough.'"

Jessica took great advantage of her home culture, which was much the same as the school culture. She did not need to change her way of feeling, understanding, and acting as she moved back and forth between her home and school. Rules and behavioral codes were very similar, and she felt and acted the same in both places. Her identity was secure and stable.

J H: I am wondering whether you feel any difference between your home and school.

Jessica: No, I don't think so (shaking her head).

J H: Do you act differently when you are at home and in school?

Jessica: No.

J H: And do you see your mom and dad are acting like your teacher?

Jessica: Yes, I do. Because they try to teach me how to act good and how to have good manners…and to treat people with respect. (Second interview with Jessica on April 30, 2001)

They Call Us Smarties: Construction of Collective Identity

Jessica's social world was filled with friends who came from similar cultural and SES backgrounds. She observed, "All my friends love school" and "like mathematics." Her social experience with such friends helped her accept the culture of the mathematics classroom, even though its competitive nature made her feel anxious at times. Clearly, she had formed a more collective identity with her friends, and this often helped her sustain her confidence and motivation even in a competitive, procedural, and instrumental learning situation. "They call us smarties. . . I take that as a compliment." Grounded in her collective identity with her smart friends, Jessica hardly doubted her ability to be a good mathematics student.

Mrs. Oliver knew that Jessica had all her close friends in the first period, an upper advanced class. The majority of the class would be placed in the pre-algebra class next year. "Most of her (Jessica's) friends are part of that first period class. So she would probably just be part of the group. . . . Most of the time it's [students] out of that first period class that she associates with and spends a lot of time with." Mrs. Oliver believed that Jessica belonged to the first period group. She felt that it was natural for Jessica to "get into that pre-algebra class" along with her close friends.

The construction of Jessica's positive and collective identity in the mathematics domain was often based on an implicit marginalization or accusation of others whom she believed were

different from herself and her friends. Separating herself from others seemed to be essential in the construction of her positive identity.

> J H: Tell me more about those friends and why they think coming to school is just a waste of their time.
>
> Jessica: I don't really have friends that are like that. But I know that there are a few people like that.
>
> J H: Can you tell me more about those people?
>
> Jessica: When they come to school, they're like, oh man, I hate school, I don't want to be here. And they don't really make good grades because they're usually sleeping or not paying attention or drawing. Something that does not have to do with the class. So, I really don't understand why people do that because I think school is very important.
>
> J H: And you said you don't have such a friend, right?
>
> Jessica: All my friends love school. (First interview with Jessica on March 6, 2001)

To Jessica, students who seemed not to understand the importance of schoolwork did not deserve a good grade, additional support, or special care. Her description of such students often reflected an ethical or moral judgment against them. Jessica wanted to give a high B to her mathematics class because there were "six or seven people in the class" who "misbehaved a lot." In the same vein, she was rather selective about giving help to her classmates. She tended to separate or distance herself from those whom she believed did not deserve her care or help. She said, "I usually don't help them if they don't pay attention because I think that it's not right that they didn't pay attention." She internalized much of the justice principle that Mrs. Oliver practiced in the classroom and used it as her own. Armed with the justice principle, Jessica effectively separated herself and her close friends from other students who were "not paying attention" and did "not make good grades." Her identification with the teacher and her high-achieving peers became strengthened, as did her positive identity in the mathematics domain.

Not Everybody: Interplay of Cultural/Social Capital

Jessica' positive identity in and sustained motivation for learning school mathematics were founded on the abundant cultural capital (see Appendix G for definition) provided by her family and peers from similar sociocultural backgrounds (Calhoun, 1993). She possessed various resources and people to access for help when she confronted a crisis in her motivation and identity in learning mathematics. She also had a clear idea about the usefulness of school mathematics, including its instrumental value in her current school success and future professional career. Elaborating on the possible uses of mathematics in the future, Jessica firmly stated, "I want to be a pharmacist. …You should be good at math" because "not everybody can get into the college (pharmacy school)," and "it's getting very competitive."

Jessica has embodied in her personality a specific attitude and way of thinking that have helped her succeed in school. Most of those characteristics came from her family culture, while others resulted from socializing with her friends. For example, her father helped her develop a resilient attitude and assurance of her ability that were often needed in dealing with failure. Jessica observed, "He thinks I can do better on, … he'll say, 'You didn't try hard, um, you need to try harder next time.'" As a result, she easily recovered her confidence in mathematics even though she was not totally immune from experiencing failure in class. Based on this positive foundation, Jessica attributed her failure to a "careless mistake" or some other external reason, hardly damaging her positive identity in mathematics.

Her teacher's support was critical as well. Mrs. Oliver said, "She (Jessica) is one of the those I would like to see go ahead into that pre-algebra class because I think she's ready for it." Mrs. Oliver emphasized Jessica's career-oriented and hard-working attitude as the most important basis for her positive evaluation of her potential as a mathematics student.

> She's a good worker. She does her work. And she's concerned about learning. Some of them, you know, it's ok if they get a good grade, it's ok if not. But she wants to learn and

she wants to, and I feel like that she will go on to college. So she needs to be prepared and get into that pre-algebra class as soon as she can.

She talks about going to college. She's career oriented. She wants to do well. She wants to have a plan and she motivates herself a lot of times. If she misses something, she'll go back and work the problem out, and if she can't find what she's done, she'll come and say I don't understand how I missed this problem. (Second interview with Mrs. Oliver on April 19, 2001)

In the classroom, Mrs. Oliver often overestimated Jessica's performance, presuming that she already knew everything being discussed. Even though at times Jessica could not answer or explain the answer to a specific math question, Mrs. Oliver responded, "You may have forgotten," or "yes, you know. But you just have a hard time telling me."

The class was learning about proportion. However, Mrs. Oliver just moved into an equation problem after she had cross-multiplied two ratios. "What do we need to do? Jason?" "Isolating the variable," Jason said confidently. "Isolating the variable," the teacher repeated. "To isolate the variable in an equation, what do you have to do, Jessica?" Jessica tried to say something, but she soon realized she did not know the answer. "It is. . . (paused) Uhm. . . (paused again)" She looked at the board trying to figure out what to do next. The teacher waited. "I don't know," Jessica said in the end. "Yes, you know. But you just have a hard time telling me," the teacher said. (Observation in advanced class on March 7, 2001)

Mrs. Oliver said, "I expect her to take college prep courses. I hope that she is able to get into pre-algebra." She believed that Jessica would "go on into algebra I, algebra II, and upper level math classes because now in high school you have to have core math to get into a Regent's college. So, I expect her to be on track." Mrs. Oliver also expressed high expectations for Jessica's future career. "I look for her to be a professional. I don't know if it will be in some kind of medical field or teaching."

It's For Extra Credit: Captured by Instrumental Value.

One interesting aspect of Jessica's attitudes toward work in school mathematics was that she eagerly committed herself to competitive, repetitive, and often meaningless work without much pain or hesitancy. Getting a good grade, being acknowledged as an excellent student, and successfully surviving the competitive streaming practices at the school were her most important goals and reasons to perform a given task. Jessica never asked why she had to learn mathematics and spend such a long time to do extra work. She had sufficient reason to work hard as long as she was sure that her current work would have a strong instrumental value for herself sooner or later. At the same time, she reinforced her self-confidence and feeling of accomplishment through participating in this type of work.

J H: What do you think is the best way to learn math?

Jessica: …to do some extra credit and to do work that is unassigned so you can just practice it.

J H: Then do you do some extra work?

Jessica: Yes, I do.

J H: Besides your homework, what would you do?

Jessica: The other day she gave us some pages to do for extra credit. And it was how you had to get a white piece of paper and draw like little squares all over the piece of paper and do the same shape in each square and color it different colors and you would get an extra 100 for that.

J H: I saw it on the back of the classroom. That was yours, right?

Jessica: Mmhm. So I did that, and I got an extra 100.

J H: Ok. Actually what was it for?

Jessica: It's for extra credit.

J H: Yeah. But what is the meaning of that work in math?

Jessica: Uhm…I don't know… (paused) I think it was to learn how to measure things.

J H: Ok. So you think it was about right measurement.

JESSICA: I guess so. ….

J H: Mmhm. I saw only one.

Jessica: Mmhm. (answered quickly, obviously very proud of this) (First interview with Jessica on March 9, 2001)

Road to Success

Clearly, Jessica was on the right track. To some extent, her world was carefully constructed and orchestrated by her parents and her teachers. Her family and school, represented by the mathematics teacher, formed a strong alliance that supported her smooth journey between her home and school as well as throughout her schooling process. Both parties shared White middle class cultural values, such as strong self-discipline, an ethic of hard work, and meritocracy. Being exposed to the abundant cultural capital at her home and among her peer group, Jessica knew that school success was a competitive game and she had to win this game to reach her professional goal--becoming a pharmacist. Her parents, friends, and teachers constantly transmitted a positive message to her, reaffirming her ability, the legitimacy of her goal, and her way of pursuing it. As a result, Jessica did not hesitate to jump into the game; she was so sure that she would be a winner. She had strong confidence in her ability and was aware of the path she needed to follow to achieve success. Also, she knew that her family and teachers would work with her through every step. Jessica eagerly accepted a meritocratic ideology (see Appendix G for definition), internalized it, and used it to construct her own social world with her close friends--the "smarties." Furthermore, she developed an ethical standpoint that reflected the justice principle adopted by Mrs. Oliver in her mathematics classroom. Though she applied the principle not only to others but also to herself, it conferred on her an extraordinary power and logic to distance and marginalize other students who seemed not to share the same attitudes as hers toward school and learning.

Unfortunately, however, she seemed to have lost, to some extent, her genuine curiosity, insight, and critical voice to discover the intrinsic meaning of many activities in which she was engaged everyday. Many things were viewed in the light of its instrumental value. Instrumental reasoning came to exert great power in her consciousness, even though she did not realize it. And she did not, and possibly could not, resist even the negative side of instrumental reason as criticized by early Frankfurt school theorists (Horkheimer & Adorno, 1947: 1972). Her enthusiasm and conformist attitude toward school success seemed to impede the development of her ability to think reflectively and to explore different, but possibly valid, meanings of her own choices and actions. The negative consequences of instrumental reason in modern society was being becoming ingrained in her consciousness, enabling her succeed as a student, but perhaps tainting her success with the unrestricted power of instrumental reason.

Stella: Between Two Worlds

The world of school mathematics experienced by girls from marginalized backgrounds was radically different from that of mainstream girls like Jessica. Stella, a high-achieving African-American girl from a working class background, was one example. Her experience with school mathematics was much less positive than Jessica's. Situated between two different worlds that contradicted one another, Stella developed an extremely fragile identity in the mathematics domain.

To my first impression, Stella was a quiet, meticulous, and hard-working student. Though she was a bit taller than other sixth grade girls, her full face and cheeks and her big round black eyes made her look rather cute. Like her best friend, Brenda, Stella was round though not fat. Her dress and hairstyle were simple with few changes throughout the semester. She usually wore pants or shorts and a simple colored round-neck T-shirt. Her long black hair was always braided with a long hair tie.

In fact, I did not know Stella well before I had the first interview with her. During the interview, she surprised me by revealing unexpected sides of her personality, "real loud" and

"wild." Stella turned out to be a cheerful and social girl, proud of her outstanding singing voice and athletic talent. However, in her mathematics classroom, Stella always sat in the back near the door, hardly asking a question or speaking in public. Even when she received a high score on a test she tended to rapidly slide the test sheet into her folder before her friends noticed her good score.

Higher Anxiety and Frustration

Stella was one of only three African-American girls who would possibly enter the pre-algebra class next year; yet, she suffered from a high level of anxiety and fear in her mathematics classroom. All of her three interviews revealed her uncomfortable feelings about mathematics class and learning mathematics itself. Even before she entered the classroom, Stella had predicted that "it (would) be messed up all the time, messed up everywhere." During the class, she constantly prayed, "please don't call on me, please don't call on me."

> Well . . . (paused) when I get in there, I'll be thinking that we're going to do something hard that day. . . (paused) It be messed up all the time, messed up everywhere. And stuff like that. . . . (omitted sentences) Um. . . (paused) well, sometimes I feel nervous and stuff like that, because I probably won't get what we're going to do today in math, and it'll probably be hard. And when I get in there sometimes my stomach starts hurting. And the first day I went in there I didn't talk. I didn't do nothing. My stomach was hurting real bad. I was just like nervous. I didn't ask no questions. I just sat there. And when she called on me to do something, I just...didn't say anything, I just sat there. I was scared. (First interview with Stella on March 6, 2001)
>
> ---
>
> Stella: It's sometimes when I go in Mrs. Oliver's room I feel...scared, like she's mean. So I don't feel all that comfortable with her class.
>
> J H: What makes you feel so uncomfortable?

Stella: Because when she calls on me I be thinking that I don't know it and my mind goes blank. But I heard it and I'll be like. . . (paused) I just stop and just sit there.

J H: Do you feel uncomfortable being called on (by your math teacher)?

Stella: Yeah, sometimes I hope she don't call on me to answer a question because I don't know if I be having it right. And I'll be like please don't call on me, please don't call on me. And she'll call on somebody else. And I'll be like thank you. But then it be some more problems. But still she probably don't call on me that time, but she'll call on me the next time. (First interview with Stella on March 6, 2001)

Just Different: Cultural Conflict Between Home and School

Like other girls from marginalized ethnic or class backgrounds, Stella described the dislocation of her two different social worlds--the world of her family and friends, and the world of school and mathematics. Stella explained the huge difference in her identities, her ways of feeling and acting, when she was in school and when she was at home. She could "get wild' at home, while she became very "quiet" at school so that she would not "get caught" or "be in trouble." She depicted her home as a place of freedom and full of warm emotions where she was accepted as she was.

J H: Do you act differently when you are at home and when you are in school?

Stella: Yes.

J H: Tell me a little bit about that. How you act differently in two places.

Stella: At school everybody thinks I'm quiet.

J H: Hmhm (smiling), I thought like that.

Stella: I'm real, real loud.

J H: Then, is it ok to talk a little bit loud at home?

Stella: Hmhm. To me it is. Because we can't talk that loud here at school. . . . (omitted sentences) When I'm on the phone with them, they don't talk the way they talk here. In

here they talk all like they shy and stuff and they don't cuss in there. But they do when they're on the phone.

J H: Why do you think you are acting differently when you come to school?

Stella: Because when I'm at school I'm not wild like I am at home. I'm just, well, like yesterday I was riding my go-cart and I was going to run into the bushes because I was just going side to side. I was just doing what was happy. (Second interview with Stella on April 25, 2001)

In contrast, Stella perceived the school, especially mathematics class, as a dangerous place where the teacher was "always on your back," constantly monitoring and controlling her behavior. It was not surprising that the teacher perceived Stella as "a very quiet and sweet girl," while Stella herself believed that she was "real loud" and even "mischievous sometimes." She experienced constant anxiety because of this fracture of her identity between the two worlds, her home and school.

Unfortunately, Stella's parents were unable to effectively support her transitions between her home culture and the culture of the school and mathematics classroom. Clearly, they had a strong desire for her success in school and did their best to achieve this goal; yet, they were unaware of many school practices and "couldn't understand" teachers. They often taught Stella ineffective strategies to solve math problems, and this simply made her more confused. Her mother had little confidence in her ability to help with Stella's math homework and expressed her feelings of discomfort and helplessness associated with mathematics and school overall. In particular, Stella's cousins negatively impacted her mathematical identity by repeatedly presenting a worst-case scenario of her future mathematics class.

They got me scared because they were saying it's going to be real hard and stuff like that. They say even though you're smart it's probably going to be hard to do what you . . .like knowing the stuff like that. . . . So. . .I got scared. . . . They'll be making me scared like you're going to have to do a lot of math and you're going to have to turn in all this. I got

> real scared because she said you're going to have to turn them (worksheets) in Friday. Or probably she'll make you turn them in earlier. And it's going to be having some hard questions on it. And she (Stella's cousin) would tell me that "I always fail my math sheets," so I thought they'd probably be real hard, because she was smart. She was smart." (First interview with Stella on March 6, 2001)

Unlike Jessica's social world full of emotional support and academic resources, Stella's social world had little supporting structure to facilitate her positive mathematical identity, leaving her all alone, intimidated, hurt, and even scared. Most of the knowledge and social experiences she had acquired from her family and friends did not help her to develop a positive identity in the mathematics domain. Rather, they fostered in her mind a high level of anxiety, negative self-prophecy, and self-doubt about her ability to achieve excellence in the domain.

To Me, She Do: Dislocation of Social World Within School

Stella's position among her peers also posed a serious problem in her struggle to adopt the justice principle and to identify herself with her mathematics teacher. Her social world at school was divided into two different parts, one relating to her peers and the other to her teachers. To my question asking her to describe the mathematics teacher in detail, Stella replied:

> I don't really know her height, but, she's like not short, but like tall in the middle kind of. That's all I can say about her looks. Well, she's a good teacher. Some folks say she's mean. Because when they ask for help she'll probably. . .(paused) probably don't want them. . . .(long pause) Well, if they ask for help and she'll tell them, but they probably won't get it that good, so they'll probably say she's mean like that. But I think she's nice. I get, whenever she be talking about a subject, I get it, because she explains it good. To me, she do. But I don't know to other people, how other people think and (whether) she explains it. . . . (omitted sentences) I don't know. (Second interview with Stella on March 25, 2001)

In this interview excerpt, Stella revealed her confusion and inner conflict in understanding her mathematics teacher and friends because her own experience with the teacher had been very different from her friends'. Stella's social world in and out of school consisted of rich relationships with other African-American girls. Her desire to maintain a good relationship with both the teacher and her friends became very difficult, splitting her identity into two incompatible parts. In her explanation, Stella tried to escape from this confusion by emphasizing her subjective knowing, "to me, she do." She chose to close her eyes to the experience of her friends and turned away from understanding them. In the end, she drew herself back into an intentional ignorance: "I don't know." This response poignantly revealed her inner conflict between two different social worlds and her unconscious desire not to see the conflict residing deep in her heart. Stella's subsequent answers about the teacher and her friends were inconsistent, revealing her insecure feelings and contradictory knowledge about two hostile worlds existing simultaneously within the school. She knew intuitively that something happening at her school was not just, fair, or even coherent. In her second and third interviews, she recollected many incidents in which her brother, close friends, and even she herself had been unfairly treated at the school. Yet, she tried to ignore the negative aspects of those incidents and to avoid identifying herself with those "trouble makers." Sometimes, she expressed her frustration and anger toward the unjust school practices, and at other times she said that the troublemakers deserved the negative consequences they incurred. Stella was caught between two competing voices, one advocating the legitimacy of school practices and the other protesting their fundamental injustice.

Rat in a Maze: Deep Self-Alienation

Clearly, Stella vacillated from time to time between the teacher's point of view and her friends' perspective. She yearned to be recognized as a good student and wanted to identify herself with the teacher because doing so was an invaluable part of her positive identity in mathematics. However, this required her to distance herself from her best friends, with whom her collective ethnic and cultural identity had been shaped. Most of them did not have a positive

relationship with Mrs. Oliver. When I conducted a short informal group interview with Stella and her two closest friends, her friends talked openly about their negative experiences with the mathematic teacher. Stella remained quiet throughout the group interview. During her one-on-one interviews, she tended to separate herself from the students who "says she (Mrs. Oliver) is mean." In this context, her closest friends became "other people" whose experiences and thoughts she "did not know." Stella stood between two worlds, afraid of being separated or ostracized from either. Therefore, it was not surprising that Stella confessed a deep self-alienation in learning mathematics. Proceeding without relevant knowledge and supporting cultural and social structures, she did not know what she was doing, why she was doing it, or what the end result of her struggle would be. The following interview data poignantly shows Stella's lonely and painful struggle in her mathematics learning.

> JH: What comes up in your mind when you think of mathematics? What kind of image, what kind of things do you think when you hear math?
>
> Stella: Uh, I think of…problems that be real hard like…I think of all this stuff and it be like, hard stuff. That I probably ain't going to get. Because I just, when I hear math, I think of stuff that I don't even know. Like…stuff like, I can't think of none now. I went blank again.
>
> J H: Can you think of any specific things or animals or places that you can compare with math? You feel like you are in some places like?
>
> Stella: I think of math like… I'm in some kind of hard thing that I'm trying to get out of. Like a maze. I'm like a rat. You know how they put the rat in the mazes. I think of that. And I'm trying to get out, but it's hard, too hard. (First interview with Stella on March 6, 2001)

Stella wanted to be a good student and hoped to be different from her brother, who was a "trouble maker" both in school and at home. She tried hard to endorse and accept "the fair-school ideology" (see Appendix G for definition) and to identify herself with her mathematics teacher.

To accomplish these goals, she consciously changed her way of talking and acting at school. Yet, she held deep doubts about the meaning of her hard work and the possible consequences of her commitment to academic success. She was exposed to, and partially internalized, two different--and contradictory--voices. On one hand, she wanted to trust the conformist voices asserting the legitimacy of school practices and the value of academic success. On the other hand, she heard the voices of resistance negating the legitimacy of those same school practices and revealing their fundamental injustice. Caught between the two antagonistic voices accusing each other of being unjust or worthless, Stella struggled to attach a coherent meaning to her academic endeavors, including learning school mathematics. She searched desperately for a way "out." In her current world, learning mathematics was a rather confusing, painful, and self-alienating experience from which she simply wanted to escape.

As a Secretary: Not Knowing the Instrumental Value of Mathematics

Generally, high achieving students in the advanced mathematics class were well aware of the instrumental value of mathematics for their future careers. Most of them acquired that type of knowledge from their families or their peer groups. In contrast, Stella had little concept of the relevance or value of mathematics to her own life situation or future career, although she cited a few examples mostly derived from her limited life experiences. She was unaware of the importance of school success in materializing her dream of becoming a pediatrician. Her knowledge of the instrumental value of mathematics was fragile compared to girls from a White middle class background.

J H: Why do you think people have to learn math?

Stella: Because when you get a job, like if you get a job dealing with numbers and stuff. Like if you work at a store you're going to have to know how to add up the numbers and stuff like that. So you'll know how much they got to pay.

J H: Mmhm.

Stella: Or like if you get a job as a secretary, you'll have to know your math.

J H: Mmhm. Anything else you can think of why you have to learn math? Why people have to learn math?

Stella: (shakes her head, meaning no more)

J H: That's it? Then, don't you think that you already know how to count, like how much you need to pay and how much you need to get in return at stores? Then, do you think you don't need to learn math anymore?

Stella: No.

J H: No. Why? Because the reason you just gave me is enough for you to finish learning math now because you learned all of them. Then why are you still learning math?

Stella: Well, we're learning...so we can, um...I don't know. That's the only reason for. . .(paused) I don't even know. (First interview with Stella on March 6, 2001)

Low Expectation and Negative Self-Prophecy

Unfortunately, Stella's struggle for school success was not being adequately supported by her teacher either. The teacher hardly understood the inner conflicts that Stella had and failed to appreciate her potential for learning mathematics. Stella and her close friend, Brandy, always took their seats in the back of the classroom, where they would "feel more comfortable." Stella's test scores and grades were higher than Jessica's, but the teacher evaluated Jessica's mathematical ability higher than Stella's. The teacher's expectation for Stella's career was "two year college or maybe four year? And semi-professional job." The teacher underestimated Stella's mathematical ability because she was not an active learner and her working speed tended to be a little slower than other high-achieving students. The teacher did not know that Stella reviewed her answers meticulously before she put down her pencil, partly because of her high anxiety about mathematics. Stella was not on the teacher's recommended list for the pre-algebra class for seventh grade while Jessica was.

Beneath Mrs. Oliver's rather reserved evaluation of Stella's mathematical potential lay another issue. Mrs. Oliver doubted whether Stella was working hard, which she often considered

the most important individual characteristic for learning higher mathematics. Mrs. Oliver observed, “She (Stella) doesn't seem to be as interested in her academics as a whole.” The teacher believed that Stella did “not want to get out of that box (comfortable zone) into a box where she’s going to have to struggle.”

> Mrs. Oliver: I don't know if it's from outside this class, but I don't think she wants the attention of being a goody-goody or doing too well. I think she's happy just doing what everybody else does. And she could, I think, do a lot better. Simply because she likes where she is, she's comfortable. She likes that area of comfort. She's making good [grades]. She's doing well. And so she doesn't want to get out of that box into a box where she's going to have to struggle. She likes that comfort zone.
>
> J H: So she does not want to be challenged too much?
>
> Mrs. Oliver: Right. I don't think she wants a challenge. I think she just wants to do what's assigned to her, and she will do it and do a good job. (Second interview with Mrs. Oliver on April 19, 2001)

Mrs. Oliver deplored the fact that Stella “doesn’t say ‘I can do better than this,’ or ‘I'm going to see what I missed and see if I can pull it up.’” Mrs. Oliver did not understand that Stella suffered from an extremely high level of anxiety in the mathematics classroom. She simply viewed Stella as a passive learner, or, at best, not as motivated as she should have been. “She's (Stella) just content making just that,” said Mrs. Oliver.

Stella herself was not sure about which track she really wanted to enroll in for next year. On one hand, she hoped to study in the pre-algebra class even though she was concerned that might be a “too smart” class for her. On the other hand, she wanted to be with her friends in a regular mathematics class. “I don’t know,” Stella said again. She repeated, “I don’t know” forty-eight times throughout her three interviews--six times more than Jessica who said “I don’t know” only eight times in her three interviews. The clash between her social world and her desire for school success persisted, forcing her to say repeatedly, “I don’t know.”

Celestina: Acrobat in a Relational World

Celestina, the only Hispanic participant in my study, was one of the most popular girls in sixth grade. She was tall and slender, reminding me of several cover girls featured in girls' popular magazines. Her large dark brown eyes sparkled under extremely long, beautiful eyelashes contrasting with her ripe peach-colored facial complexion. Definitely, she had much whiter skin than other Hispanic girls at the school. Her long, slightly curled dark brown hair flowed down to her shoulders, and she would twirl it around her fingers when she got bored with her work in the middle of class.

Celestina's family originally came from Cuba. Her grandfather was a prominent medical doctor, and her family was very affluent before the Cuban Revolution. After the revolution, Celestina's family, including her parents and other close relatives, relocated to the United States. Her mother passed away several years ago, and her father was living in Tennessee. During this study, Celestina lived with her aunt and uncle, whom she called "Mom" and "Dad." Her elder sister and younger brother also lived in the family along with their baby cousins.

At school, Celestina was always surrounded by her female friends and boys. She enjoyed being in a crowd and always sat in the cafeteria with her close friends, Ashley, Crystal, Jennifer, and Courtney, all of whom were White. They would practice a new popular song, share secrets, and giggle with each other constantly until the bell rang. During lunch period, Celestina paid close attention to all the major and minor things happening among her friends and whether she was included in the various social events going on at PCMS. Toward the end of lunch, she often opened her small stylish shoulder bag and retouched her make-up. Her pink and white vinyl cosmetics bag always hung on her right shoulder, and she carried it everywhere she went, including mathematics class. She treasured it like a magic box from which she drew her feminine beauty. Not surprisingly, some boys in the mathematics class longed to see what was inside the mysterious bag. They often asked Celestina what it contained, and sometimes they even tried to snatch it from her. The little cosmetics bag represented all the myths and hopes Celestina wanted

to be part of; it was not simply a bag for lipstick, powder, and a small bottle of perfume, but a material symbol of her femininity.

Always Worried: High Anxiety and Helplessness

Not surprisingly, Celestina expressed "uneasy" feelings in mathematics classroom. These feelings were usually related to situations in which she could "get embarrassed" or "get in trouble." Her first impression of middle school mathematics class was that it was something she had to "worry about."

> J H: When you first met your math teacher, how did you feel? In the beginning of sixth grade.
>
> Celestina: I was really uneasy. I get embarrassed really easy. Like if she calls on me and I don't know the answer, I get embarrassed. I just kept on worrying about stuff like that and I still get embarrassed about it. (First interview with Celestina on March 9, 2001)

Celestina's anxiety shared some similarity with Stella's. Like Stella, she did not feel comfortable being in Mrs. Oliver's class with its strict behavioral codes, constant and close monitoring, and formal and distant human relationships between the teacher and students. (see Chapter 5, findings about the classroom) Celestina viewed Mrs. Oliver as the authority she always had to be afraid of. Interestingly, she differentiated Mrs. Oliver from other teachers who were "kind of slack" and "won't really get on to me" or could not " make me do anything." She acted differently based on her perception and previous experiences with each teacher. She often exaggerated her femininity in front of young male teachers and took advantage of it. She knew that sometimes this behavior worked effectively for her. However, Celestina perceived that Mrs. Oliver was the one who would definitely catch her "every time I'd look out the window." This was the reason she was so "afraid of" her math teacher. Even during the interview, she constantly reminded the researcher, "I'm scared of her. Just don't tell her that" with an intimidated expression. From Celestina's perspective, "getting in trouble" was a crystal clear consequence in

the classroom whenever she had done anything wrong or inappropriate. She often felt that mathematics was boring, but she did her best not "to get in trouble."

> Celestina: They (some lessons) can be boring, but I don't want to lay my head down. You know when you lay your head down you'll doze off. And I'm afraid I'll get in trouble so I don't do that. (Second interview with Celestina on April 25, 2001)

However, Celestina had another reason, different from Stella's, for experiencing a high level of anxiety in mathematics: she was very concerned about tests and exams themselves. Her anxiety sprang from a realization that she might not be able to meet her family's high expectations regarding her academic performance on those tests. She felt a lot of pressure from her uncle and aunt, who were her legal guardians. Celestina's uncle and aunt emphasized the importance of schoolwork, and closely monitored their nieces' and nephew's academic progress at school. Under this degree of family pressure, Celestina suffered from frequent attacks of hiccups, an unpleasant result of her high anxiety about mathematics tests. In the end, she had to see a doctor, but her worries never stopped.

> J H: I was going to talk about the standardized math test, like the Stanford 9 and CRCT tests. Tell me about that.
>
> Celestina: It was oooo, I hate taking tests. Every time I have a test, I'm like uuhhh (making a very unhappy face), what's that. . . (paused) you know. I'm always worried. I'm always worried about something. It's like worry, worry, worry. And I'm not supposed to be worrying, but that's what actually happens. At the beginning of the year, last year, I had this little hiccup thing that used to come every time I'm worried. And I didn't know what it was from. And my mom took me to the doctor and he said it was worrying. And he asked me what I was worrying about, and I said, my grades. I mean I want to make good grades so bad, but it seems like it's too hard for me to do. Like my parents are always talking about if you don't make A's and B's, you won't make it into college and

stuff like that. And it's really, really pressuring me. (Second interview with Celestina on April 25, 2001)

Celestina's attitude toward mathematics learning was characterized by helplessness. She barely presented herself as an agent in her own learning process. Helplessness and self-distrust were deeply imbedded in her heart. She did not believe in the possibility of a more effective way of learning mathematics; she expected no change for the better in Mrs. Oliver's method of teaching; and, perhaps most significantly, she held no hope that her own attitude and efforts could make a difference. Instead, she projected that she would not be able to meet her family's expectations anyway. She deeply believed that school success, academic achievement, was something almost completely out of her control. As a result, Celestina felt that she was suffering too much under an unnecessarily heavy pressure and surveillance both from her family and the mathematics teacher. They all seemed to demand that she do something that seemed impossible to her from the very beginning. Celestina did only the minimal work required so that she would not "get in trouble" or "disappoint" her family.

Sometimes, she even thought she needed or deserved a coercive structure because she did not have self-discipline to manage the minimally required work. In the following excerpt, she portrayed her strict mathematics teacher as an inevitable evil that "scared" her but motivated her to do her homework.

> Celestina: I used to not like her (math teacher) at all. Just because she was my math teacher and I don't like teachers that much. I just don't. But I've learned some things from her. Everyday when I get homework from her, I always do hers first because I just do. I don't want to get in trouble by her. But if it's any other teacher, I'll be like, oh, ok, who cares? But if it's my math teacher, I'll make it up! (almost screaming here while making an intimidated face) I'm pretty scared of her. (Second interview with Celestina on April 25, 2001)

They Just Have the Ability: Genetic View of Human Intelligence

Celestina suffered from various forms of cultural myths widespread in our society. Those ideologies ranged from the view of human intelligence and personality as innate to a gender-based difference between boys' and girls' abilities to learn mathematics. She described herself as a "really lazy" person: "I'm just a lazy type of girl that doesn't like to do work. You can even ask my parents. They're always on my back doing chores." Celestina believed that was her nature, something she could not change.

Celestina's attribution pattern also reflected her view that mathematics learning was something out of her control. She attributed her academic failure to her "easy" third grade teacher who had not prepared her well for the next grade. She said helplessly, "I think it's kind of my teacher's fault … but there's nothing I can do about it now."

> Celestina: I was making all As in third [grade]. In fourth I brought my grades down. In fifth I got a little better. But it was...I think it's kind of my teacher's fault because she treated us like second graders. She made it so easy on us, and I kind of got used to it, a little too used to it. But you know, there's nothing I can do about it now. (Second interview with Celestina on April 25, 2001)

A genetic view of human intelligence was another striking aspect of her understanding of human ability, including an individual's ability to learn mathematics. Celestina believed that some people who had the "brain" did not need to work as hard as she had to. She assumed that her brain was not good enough because she "forgot some." Her incompetent brain was the main reason why "whatever we're doing right now is difficult [and] hard." She sighed, "I guess they just have the ability to remember more than I do." The following two excerpts strikingly reveal how deeply she believed the myth that some people were genetically smarter than others. She named a few boys who just had the "brain." She emphasized how unfortunate it was for her not to have that ability, "brain," or "larger remembering area."

Celestina: I'd make better grades because it (SWIS class) might be on a level that my brain is on. . . . (omitted sentences)

H: Then, do you think that some people have kind of better brains for math?

Celestina: Drake.

J H: How did you know that?

Celestina: Because he's always making good grades. Never received a bad grade on his math worksheets or math tests, and anything. Just makes me sick. I wish I could have a brain like Tommy's. He doesn't even have to study for anything. He makes As and Bs, always. And one B. It stinks. Because I gotta work for mine, and he doesn't have to do anything. (Second interview with Celestina on April, 25, 2001)

Celestina: That boy (Tommy), he doesn't even have to study and he'll get a 100 on his test.

J H: How can he be like that?

Celestina: I don't know, he's just like that. And it drives me crazy.

J H: Why does it drive you crazy?

Celestina: Because I wish I were like that. I wouldn't have to study and I'd get so good grades. But him, oohh!

J H: But do you really believe he gets all 100s even though he doesn't study hard?

Celestina: Yes. Because it's happened to him before. He used to be in my fourth grade class and he got straight A's. He can do [it] by studying a little bit. I know him a lot. We've been close ever since third grade.

J H: OK. So do you think that Tommy has something you don't have, which makes him get 100 even though he doesn't study?

Celestina: Yes.

J H: What do you think it is?

Celestina: I think he's got a larger brain than I do. If you notice his head is like... (trying to show a big head with her two hands up and giggled).

J H: His head is kind of larger than yours?

Celestina: I think he has a larger remembering area because his (head) is kind of clumpy. (First interview with Celestina on March 6, 2001)

Celestina wanted to move down to another mathematics class, which she called "not a regular class." Since the previous year PCMS had been running a pair of SWIS classes for students whose academic achievements were much below their grade level. Celestina believed, "it might be on a level that my brain is on." She never trusted her own ability to become a good mathematics student. Even when she had a good grade in mathematics, she attributed her success to extra effort rather than ability: "I've been getting good grades on it (a difficult part), but I guess because I'm trying, trying hard." Celestina stated mostly self-destructive attributions for both her success and her failure in mathematics. When she received a good grade or score, she attributed it to her effort; when she failed, she took it as a result she had expected because she did not have the "brain" to succeed.

It's Too Hard For Me: Pressure From Cultural And Social Capital

Though Celestina's family were immigrants from Cuba they were well established in the Pine County community. Her uncle, who operated his own business, was able to comfortably support his own family, Celestina, and her two siblings. They attended a local Protestant church and were well accepted in the religious community. In addition, Celestina's aunt maintained a good relationship with the school. She communicated well with teachers at PCMS and regularly attended a parent-teacher conference each semester.

Celestina's uncle and aunt were well aware of the importance of school success in their children's lives. They also knew the negative consequences of being placed in a lower stream, such as "SWIS" classes at PCMS. Celestina's elder sister was already in the seventh grade SWIS class, and they did not want Celestina to follow her elder sister's undesirable path. Therefore, at

the very beginning of school year Celestina's aunt visited the office and asked to change her placement from a SWIS class to a regular class.

> Celestina: I was supposed to be in a lower math class, but my mom got mad and they put me in this class...
>
> J H: Then have you been in the second period from the beginning of the sixth grade?
>
> Celestina: Mmhm. See, at the beginning, you know how you come before school starts like a week later, two weeks. And you meet all your teachers. Well, that's what my mom did, and she, we got the little card, and it said that I was in a low math class, and my mom didn't like it. So she went up to the office and told them.
>
> J H: Then what did the office say to her?
>
> Celestina: I think they said something like they'd change it. But I didn't really care because if I was in the low math class, I was in the low math class. I'm sure nobody else would care. (First interview with Celestina on March 9, 2001)

Celestina's uncle and aunt tried to do their best to transmit their ethic of hard work to Celestina. They exerted their influence so that Celestina stayed at least in one of the regular sixth grade classes. On the other hand, Celestina also understood the tremendous importance of doing well at school. "I want to make good grades so bad, but it seems like it's too hard for me," she stated bitterly. She clearly knew the instrumental value of learning by listening to her uncle's and aunt's repeated warnings every day. "My parents are always talking about if you don't make As and Bs, you won't make it into college and stuff like that. And it's really, really pressuring me," sighed Celestina.

However, Celestina also held a strong belief that her academic achievement was completely beyond her control. Not only did she feel little sense of agency in her own learning, but she saw herself as crushed by the pressure of her family's high expectations. In the face of her perceived helplessness, she struggled to preserve a minimal level of self-worth. She tried to trivialize the effect of being in the lower-level class or learning mathematics itself. "I didn't really

care, because if I was in the low math class I'm sure nobody else would care." She then identified herself with Dawn, who was in the lower class and still seemed to be OK.

More important, Celestina was exposed to another powerful cultural influence, feminine ideology, through her "bad sister," Ariana, who was one of the most popular girls at the entire PCMS and PCHS. She was tall, slender, and a good athlete. Even though Ariana did not reflect the traditional feminine image of an angel-like woman Celestina envied her fit body, pretty face, and unbeatable popularity at the school. "My sister thinks she's so pretty and cool and beat up anybody she wants to. And she can," Celestina said. To Celestina, it was a mystery that Ariana had such high confidence, carefree attitude, and even popularity despite her low grades and bad behavior at the school. Celestina knew that what Ariana did was not exactly the right way to behave and was, at times, even dangerous. Yet, Ariana was a heroine to Celestina. Celestina longed to become like her sister because "she's pretty and popular and funny."

> J H: Tell me about your hero. A person you admire?
>
> Celestina: Well, I admire. . . (paused) I admire. . . (paused) I admire two people. I want to admire my sister but she is big trouble. So I don't want to do anything she does.
>
> J H: What kind of big trouble?
>
> Celestina: Like she fights. Like fist fights. And she talks back to teachers that won't allow it. And she gets wrote up. . . . (omitted sentences) She's just big trouble. She does things she's not supposed to, like illegal stuff. . . . (omitted sentences)
>
> J H: Then why do you admire her?
>
> Celestina: I don't. I don't. (paused) I want to. . . (paused) I want to so bad because she's pretty and she's popular and she's funny, too. (Third interview with Celestina on May 25, 2001)

Valuing Our Social Lives: Entering the Relational World

Celestina had definitely entered puberty. She was the tallest girl in her class, and her body was showing dramatic changes. She knew it was the time for her to enter the "relational world" in

order to taste and enjoy all the privileges and power that her sister had enjoyed. The emergence of the relational world is an important characteristic of women's psychological development (Gilligan, 1992). In this world, an individual's identity is deeply embedded in social interactions and personal relationships. During the last several years, Celestina had longed to enter the relational world as she observed Ariana's splendid transformation within its context. Celestina eagerly plunged into this world and was surprised to realize its complex mixture of power, delicacy, and fragility.

The first negative consequence that Celestina had to confront upon her initiation into the relational world was her plummeting grades. It was surely disappointing, but she felt that she could not control her desire for "socializing." "Everyday when I get home I want to talk on the phone, I don't want to do my homework. I don't know why …. I can't stand it." She knew that her grades had "gone really down because of my socializing." However, she emphasized that this happened not only to her but also to all members of the relational world—her close friends. Since it happened to everybody in her circle, Celestina accepted it as a natural and even inevitable consequence of becoming a member of the relational world. Celestina and her friends had already developed a collective identity that focused on goals leading them in the opposite direction from academic success. What they valued most were not high grades or excellent test scores but something else shared in their social world--socializing, being loved by friends, and being popular at school.

> J H: Do you think your friends think it's important to learn math?
>
> Celestina: No. I think they value our social lives. Like me, I'd rather socialize than do anything. I think most of my friends are like me. They'd rather socialize. See this year, about half of my friends' grades have dropped at least to an F in one class because last year it was easy. But this year, everybody I know has grades that have dropped. Kristin and I and Courtney all made an F in science. Kristin made a 63, I made a 64, and Courtney made a 67. And three of our parents are strict. Like if we don't make A's and

> B's, we're in trouble. I mean I make C's and I still get in trouble. But Kristin made her first F. I made an F before and I got it corrected. (First interview with Celestina on March 9, 2001)

Celestina's journey into relational world was often accompanied by her counterattack directed at meritocratic school ideology and "smart girls" who followed the "justice principle" in their classroom. She often reported her uneasy feelings with smart girls who appeared to threaten her relational world because they did not care about others' feelings with their cold "snobby" attitude. Celestina described her anger toward smart girls saying, "They're all mean." "All the geeky" smart girls "think they get the big head and they think they all know that stuff." Celestina detailed how smart girls had violated and ignored their responsibility for mutual kindness and caring in their relational world, and that was why "nobody likes" them. This accusation was not surprising, because high achieving girls, like Jessica and Janet, often adopted the justice principle instead of an ethic of care in their everyday lives. However, Celestina, who strongly advocated this ethic of caring in her relational world, interpreted their actions as serious violations of their responsibility to others--mutual kindness and caring.

Pretty And Nice: Accepting Feminine Ideology as a Counter Discourse

Celestina, who was deeply immersed in her relational world, accepted stereotyped feminine ideology as a way to restructure the power relationship at the school. Feeling marginalized and hurt by those "snobby" "smarties" and teachers, Celestina resorted to feminine ideology glorifying "pretty" and "nice" girls as a way to recover her positive identity. This ideology also helped her to preserve her own space within the school and functioned as a source of her relational power through various social alliances with her friends. This phenomenon emerged not only in Celestina's case, but also in those of other girls, such as Heather and Amanda, in the study.

Interestingly, despite their enriched social world filled with boys and friends, these girls were among the most vulnerable people in any rupture of micro politics at the school. They were

constantly harassed by boys and suffered from their own self-definition as “nice” and “pretty” girls. Celestina did not eat lunch at school because “it’s nasty …. to eat in front of boys.” She was extremely concerned about making a bad impression on the boys watching her at school.

J H: Do you act differently when you are at home and when you are in school?

Celestina: Yes (smile).

J H: So, tell me about that. How you are different?

Celestina: At home I don't care what I act like because I'm not trying to impress anybody. I'm not trying to get anybody's attention. So if I feel like...eating a lot at home, I'll eat a lot. But at school I don't want to eat that much because...I don't know. I just don't want to eat in front of everybody else, especially boys. I don't like eating in front of boys. (Second interview with Celestina on April 25, 2001)

Celestina described several incidents when boys harassed girls, including herself. Yet, she knew that most girls did not talk about that because they were afraid of being labeled as “uncool.” “Those boys, one … immature thing is they'll grab you right here (hip) and go like that and you'll scream, it scares you, you jump. And then they'll just make fun of you for the rest of the day.” She continued, “but I don't think many people go to peer mediation because .... they'd be considered uncool. That's why.”

One problem afflicting Celestina and other girls who lived in their relational world according to feminine ideology was that they experienced an extremely high level of anxiety and frustration in their mathematics class. The culture of mathematics classroom, mostly based on individual work and implicit but constant labeling practices, made them feel extremely insecure. Celestina was extremely sensitive to being scrutinized by boys, and vulnerable to others’ judgment and labeling practices.

“I don't like it [mathematics class] because those boys in her class make fun of me. Like I don't get something right, so I'll be like, uh, uh (deeply sighed in an embarrassed face).” Celestina described many moments in her mathematics class, such as “he (Jason) picks on me a

lot and so does Drake and Ben. Ben picks on me a lot, too, and so does Charles." She sighed deeply, "[it's] harsh, it's annoying." In the following excerpt, Celestina described a scene in the class in which she, with two other girls, was surrounded by naughty boys sitting behind her and making the situation uncomfortable and "weird."

> Celestina: I was really uneasy. I get embarrassed really easy. Like if she calls on me and I don't know the answer, I get embarrassed. . . . (omitted sentences) I just kept on worrying about stuff like that and I still get embarrassed about it. . . . (omitted sentences) And some boys follow us. . . (paused) like Ralph, Drake and Charles and Steve. Like last time I sat with Rachel and Heather, Charles and Steve was on my other side and Ralph and Drake was on the other side of Heather.
>
> J H: What do you mean by boys are following you? …
>
> Celestina: Yeah, they're sitting behind us now because they can't sit by us. It's aggravating and weird. (First interview with Celestina on March 9, 2001)

Celestina believed that she had many foes in the mathematics classroom. Besides her strict mathematics teacher, there were too many things that she had to worry about in the space. She saw "a bunch of boys that like to make fun of me in her class." Celestina also reported broken relationships among girls. "Some girls make things up because some girls just don't like me." Even one of her close friends in the class was "always making fun of me, like one time [because] I'm really slow in math." She was disheartened to find out that even her close friend was not as supportive as she had expected.

Celestina found that the cultural atmosphere of the mathematics class was extremely harsh for her. She viewed it as a place in which friends discarded their responsibility of mutual kindness and caring and instead were cruel to the people who were most vulnerable in the space. Therefore, it was not surprising that Celestina had a negative image of the mathematics class she would take the following year. When I asked what she knew about or expected from seventh

grade mathematics class, she started talking about "mean teachers" who had infringed on students' relational world.

As a result, Celestina wanted to move to "a lower" math class the next year. "Mean" teachers would be the same, but at least she would be free from boys' constant teasing and bickering when she could not answer questions in public. Her hiccups--her worries about mathematics tests--apparently did not end easily. Celestina did not know why she had to suffer so much from the pressures emanating from her family, friends, boys, and teachers, not being able to speak up in her own confident voice. Neither did she know that she was one who could make a difference in the landscape of her social and academic world. It was simply too hard for Celestina to break away from the enigmatic cycle of feminine ideology, which had simultaneously given her relational power and made her vulnerable in both her mathematics classroom and her social life at school. To her, the ideology seemed to be her only chance to retrieve her self-worth when she was trapped in the furious competition between meritocratic school ideology and the patriarchal culture prevalent in our society.

The Celestina I met was a little acrobat, walking and sometimes dancing on a high wire in the air without a safety net below. She desperately hoped somebody who knew the genuine meaning of care and love would provide a safety net for her in case she fell off the wire. Yet, the only thing she felt clearly that the safety net was not available in her current mathematics class.

Rachel: Audacious Player With the System

Rachel, an African-American girl with a strong personality, was the most challenging participant in my study. Unlike other interviewees in this study she always kept a distance between us. While I was doing my fieldwork in her classroom, she cautiously conducted her own research on me, an unexpected and mysterious intruder from outside. To my great disappointment, she almost withdrew her consent in the middle of the study after she observed me acting like a teacher during their fieldtrip. It took me more than a month to re-invite her to my study. Rachel was special. She was a unique blend of strong self-confidence and interpersonal

intelligence possessing cultural knowledge derived from experiences accumulated in Pine County's African-American community. Rachel was a leader among African-American students, both boys and girls at PCMS. Even teachers were aware of her strong influence upon other African-American students. She was the one who intentionally created and maintained a particular type of relationship with each teacher, unafraid of confronting teachers if she chose.

Rachel, the youngest in her family, had three brothers and two sisters, all grown-ups. Rachel lived with her mother and one brother who "spoiled her very much." Her father lived in an adjacent county and visited her on regular basis. Rachel was a little taller than other sixth grade girls. Her ever-neat clothes and elaborated hairstyle revealed she was well cared for at home by someone who had good taste. She was definitely one of the best dressed in the class. She changed her braided hairstyle almost every week. She decorated her hair with colorful hair ribbons, bead strings, and hairpins that always perfectly matched with clothes. For this reason, I did not expect that she lived in a trailer house located off the paved road until I conducted our second interview at her home. Interestingly, none of sixth grade teachers, including Mrs. Oliver, knew anything about her family.

Rachel was not a high-achieving mathematics student. She was in the 2nd period, which was the lowest class among three regular math classes. Mrs. Oliver used more hand-on activities in the class to "give them more understanding of the concepts" along with "a lot more practice, drill and practice." Rachel was Mrs. Oliver's "sweet one" in the class. They enjoyed a very positive relationship with each other.

I Am an A Student: Self-Confidence in Mathematics

Throughout her interviews, Rachel showed high self-confidence about her ability, current achievement, and future expectation in mathematics. She confidently said, "I am an A student in math." She added, "Math is my favorite subject." Even though she was in the lowest stream among the three regular mathematics classes, she did not admit that she was struggling with mathematics. It did not mean that Rachel knew little about the other mathematics classes in sixth

grade. She was the person who often took the responsibility to write the day's homework or worksheet assignment on their TOC sheet on the blackboard. Since three different TOC tables for each stream were put side by side, it was easy for anybody to see and compare what each class was learning everyday.

In general, however, Rachel did not pay attention to other advanced classes. She believed that she was doing well because she was "doing well" in her own mathematics class. She knew more about the remedial math classes, such as SWIS classes, Title I math class, and special education math class, than advanced classes. Rachel had a good number of her friends and cousins in these remedial classes. "I just know it's lower than ours," Rachel said. She expressed positive expectations about her mathematics performance in the future. She expected that seventh grade mathematics would be "easy" because it would be "just about a kind of teaching that you see in sixth grade." She did not worry much about mathematics: She believed that she was doing very well.

> J H: What do you know about math classes that you are going to have in seventh grade?
>
> Rachel: Well, the girl that I get off the bus with says the math, it's easy. Just about, really a kind of teaching that we have in sixth grade.
>
> J H: Hmmm. So you are not worrying much about that?
>
> Rachel: No. (Second interview with Rachel on May 22, 2001)

Rachel's criterion was not the same as mine: Hers was also different from that of other participants in my study, including Celestina and Heather who were in the same class as she. While Celestina and Heather knew there would be a benefit from being in advanced classes, Rachel hardly thought about that. Her perceived learning community shrank into a group of less achieving students, her friends and cousins. Rachel did not consider advanced classes as her option or something she had to pursue. Rather, she wanted to focus on what she had accomplished in her own class boundary. She relied on her grades and scores within the class to assess her ability and competence in mathematics. Several students in the regular class shared

Rachel's attitude. They wanted to focus on their grades within the class rather than the level of the class to which they belonged.

Great Teacher and The Delightful: Politics between Two Authorities

Rachel had a good relationship with Mrs. Oliver. She said that she would give Mrs. Oliver a perfect score as a teacher. "She is a great teacher," said Rachel without hesitancy. "She makes it [lesson] interesting by getting, like you go up there and make your fractions and stuff. And you work with partners doing the fractions." Rachel also liked her teacher because she "showed us shortcuts and stuff." Mrs. Oliver also enjoyed a very positive relationship with Rachel. "She's always been a pretty good little math student." To Mrs. Oliver, having such a good relationship with Rachel was something unexpected, but treasured for many reasons.

> Mrs. Oliver: That is so strange because with me she is always so pleasant and so kind. … She is just delightful. But Ms. Thomson says that a couple of times Rachel got on to the class as a whole and had a real bad attitude. I've seen her have a real bad attitude, however, I don't know why she has it. She's just sort of connected with me or… She just would do anything I tell her, and I very seldom have to get on to her. … She doesn't show that attitude that I've seen her show to other teachers. I have seen her get mad at other students and she can be very ugly to them. Some of these boys or girls have attitudes that just pop right out. But you know again, with me, she has always been pleasant with me. If I direct her in another way, she'll yes ma'am and she'll do it. I don't know.
>
> J H: I think she is a kind of leader.
>
> Mrs. Oliver: Yes, she is. A lot of these boys and girls will listen to her when they won't listen to someone else. That's one reason I like to have her on my side. I can tell her if her group's too loud. I say, "Rachel, you can tell your group to settle down a little bit," and she'll do it. She can get them to do just what she wants them to do. With a student like that, it's very important to keep them positive to help you with some of the others. She's a good influence in that situation. But if it goes the other way, you've lost not only her, but

also some of the other students. They support her. (Second interview with Mrs. Oliver on April 19, 2001)

Mrs. Oliver did not know much about Rachel's family. She had never met her parents or family members. Mrs. Oliver's guesses were based on Rachel's appearance and actions in school. Mrs. Oliver believed that Rachel had "a good background." "She has new clothes, clean clothes. She is very, very neat," said Mrs. Oliver. Based on her positive relationship and assessment of Rachel's attitude, Mrs. Oliver showed exceptional affection to Rachel. In other words, Rachel was one of only a few African-American girls in her five classes who could enter Mrs. Oliver's private world of caring. Mrs. Oliver's interaction with Rachel was different from her typical interactions with other students, including many African-American students. Even when Mrs. Oliver presented herself as a strict teacher, the message of acceptance and caring was evident in her interaction with Rachel.

> With me she is always so pleasant and so kind. She comes in my room seventh period everyday, at the end of bus duty. She'll come to my door, smile and say "Can I come in your room?" I'll say, "Yes, but you have to stay in a seat." She'll come in here and laugh and all, but it's ok. I'll let the students talk, but they can't be up and around. Rachel will come in here and sit with a little girl in my seventh period class and she is just delightful. …But if she were not to do her work, I would say, "I'm disappointed. I know you can do better than this." She doesn't get mad at me. She doesn't show that attitude that I've seen her show to other teachers. (Second interview with Mrs. Oliver on April 19, 2001)

However, Rachel did not identify herself with Mrs. Oliver or other Caucasian girls with a middle class background. "They're not like [me], because we don't have common things," Rachel said. Rachel did not feel that any teachers at the school were like her. Rachel had a very strong sense of self that kept her a good distance from her teachers.

> J H: Do you know any teacher who is more like you at the school?
>
> Rachel: No.

J H: No? No one?

Rachel: What, what do you mean?

J H: A teacher who may be thinking like you, acting like you.

Rachel: No. Not… No teachers. (Second interview with Rachel on May 22, 2001)

As Rachel was a special African-American girl in Mrs. Oliver's class, Mrs. Oliver was an exceptional teacher uniquely respected in Rachel's world. Rachel applied different criteria for Mrs. Oliver, which had little consistency with her overall ideas about school and people within it. Sometimes, Rachel advocated Mrs. Oliver's way of teaching and her justice principle. At other times, she emphasized her subjective knowing--"to me, it is"-- to confirm her positive relationship with Mrs. Oliver.

There was an interesting dynamic between Mrs. Oliver and Rachel. On one hand, Mrs. Oliver recognized and affirmed Rachel's influence as a peer leader. Rachel, on the other hand, responded to the teacher with her best respect. Mutual respect for each other's authority existed between the two. However, not all sixth grade teachers in the hall had as positive a relationship with Rachel as Mrs. Oliver established. In fact, some teachers considered Rachel very difficult to handle, at least in part because she did not mind having an "ugly" confrontation with a teacher when she felt it necessary to do so.

It Should Be Equal: Living With Two Incompatible Philosophies

Rachel's exceptionally positive relationship with Mrs. Oliver was accompanied by tension between the two individuals and within Rachel's mind. Rachel intentionally ignored the discrepancy and accepted what she liked most within each context. Rachel knew that the majority of her friends thought Mrs. Oliver was a mean teacher who harshly practiced her justice principle. Therefore, to some extent, Rachel had to deal with the explicit tension between her friends and the teacher. Interestingly, Rachel said the almost same phrase Stella used: "To me, she is." Emphasizing their individualized experience and subjective knowing seemed to be the only way for Rachel and Stella to resolve their inner conflict between the two different worlds to which

they belonged or hoped to belong. In the following excerpt, Rachel affirmatively elaborated Mrs. Oliver's justice principle.

> J H: What do you think about your teacher?
>
> Rachel: Ok. Sometimes she's nice, sometimes we can make her mean. But most of the time she's a pretty nice teacher. To me she is.
>
> J H: Give me an example when she's nice and when she's not nice.
>
> Rachel: We actually make her, some kids make her be mean. They act up and do stuff that she tells them not to do twice, or three times. So then she starts getting mean, getting mad, you know, teachers get frustrated when you do stuff they don't want you to do. And like when we do what she wants us to do, we're quiet, she'll be nice to us. You know you have to show the teacher how you want to be treated, so, like we act bad, then she's going to be mean. So we act good, she'll you know, but most of the time she's real nice. She helps you when you need help. (First interview with Rachel on March 9, 2001)

However, Rachel revealed a completely different point of view when I asked her what grades she would like to give to boys and girls in her class in her second interview. When she turned into the person who could make a judgment and give students grades, she adopted a different principle from the one she had elaborated before. Rachel said, "It should be equal" between boys and girls even though she acknowledged, "Two of the boys in my math class always get in trouble and girls always have their homework and they don't want to get in trouble like most of the boys." At this time, she weighed the "equal[ity]" principle more important than the justice principle. The same discrepancy was also found as Rachel described what she would do if she taught a mathematics class in the future. Above all, she advocated an ethic of care and focused directly on students struggling in the class. She expressed compassion and support for "two students who didn't get it," leaving behind "the half of the class (who could) do (the work)" in order to help the two students in need. "They're not raising their hands or something," Rachel

observed of the two students. She knew that this was an authentic experience of her friends even though it was not her own.

> J H: Let's imagine you were a math teacher in the future. What kinds of things are you going to do?
>
> Rachel: I would teach one section of a chapter at a time and make sure everybody is getting it. And then I am going from one thing [to another]. And [if] having like two other students didn't get it, then [if I] go to another section of the chapter and they don't get that either. Half of the class do [understands] but they [two students] didn't do. Well then, they might be getting behind in their work and stuff because they don't get it. . . . (omitted some sentences) They're not raising their hands or something. So you have to make sure everybody knows what they're doing. (First interview with Rachel on March 6, 2001)

The Classes That We Didn't Have: Context of Mathematics Learning

Rachel's understanding of mathematics resembled that of Mrs. Oliver. To Rachel, mathematics meant a lot of work. "We have so much [that] you have to do," she said. She also endorsed the authoritative approach to teaching and learning mathematics, believing that following the teacher's directions was the most effective way to learn mathematics.

> J H: What do you think is the best way to learn math?
>
> Rachel: Going by the directions the teacher gave me instead of trying to take a shortcut that you think you can do it. That's what she told us.
>
> J H: How about your opinion? Do you also think exactly the same thing?
>
> Rachel: Well, I think that's right. Because like you are playing with the way you want to do math, it might be going wrong with the lesson that the teacher wants you to go by. (First interview with Rachel on March 6, 2001)

Rachel liked competitive games in class. She found it "pretty fun." Since she was a good student within the regular class, she was not concerned about her ability to "get the problem done first." Neither did she feel embarrassed when called by the teacher or in making a small mistake.

In Rachel's world of mathematics learning, extrinsic rewards were prevalent. She was used to having those extrinsic rewards such as candies, presents, or money as she successfully completed her assignment or had a good grade on tests. Rachel constantly thought about those rewards; they were an important part of her motivation. In addition to the rewards mentioned, Mrs. Oliver gave library passes to students who completed their work while others stayed on to complete their work. Rachel was one who often got a library pass.

Despite her high confidence and positive relationship with the teacher, Rachel had several problems succeeding in the mathematics domain. First, Rachel totally ignored the fact that she could learn more, much more than what was required of her in the regular class. Rachel hardly recognized the possibility of a more challenging level of mathematical learning. Nobody showed her the door to higher learning or opened the door for her. Even though she was one of the high-achieving students in the regular class, she did not think she wanted to move up to another, more challenging, class. Her family and social world provided her little impetus. She was surrounded by her cousins and friends who struggled with mathematics more than she. This made Rachel conclude that she was doing very well in mathematics.

Mrs. Oliver did not believe Rachel would accept a greater mathematics challenge. Though Mrs. Oliver described Rachel as a "delightful" student, she did not see Rachel going to college or having a professional job in the future. Mrs. Oliver's expectation for Rachel was "a tech school or some other schooling after high school" with a great possibility to "just get a job when she gets out of high school."

Being in the "regular class" gave Rachel a serious disadvantage. The teacher wanted to make the curriculum easier for the class and often skipped content "to give us [them] break" or let them to do "less work." Mrs. Oliver perceived students' abilities to be very different in each

period. She had different expectations for each class and adjusted her teaching strategies based on her perceptions of students' abilities.

> What I try to do with that second period class is give them more understanding of the concepts. I try to be more hands on. I try to use more illustrations. I do a lot more practice and drill with them. In my fourth period class, I feel I can show them an activity or let them participate in an activity. They can read the short directions and go on with it and understand it. But in the second period, I have to show them, I have to practice with them. Sometimes I can finish a lesson in one day in that fourth period class that takes me two or three days with my second period class. (First interview with Mrs. Oliver on February 16, 2001)

Since Rachel was one of the high achieving students in the class, she usually finished an assignment faster than others. She often had some free time in the class. "I am just playing around," Rachel said. "Most of the time I draw people playing basketball or butterflies or stuff like that. Or just write stuff." Her notebook was filled with many interesting drawings, neatly colored sometimes. Once, she even composed a poem about mathematics during the class. "If I'm done with my work, I ask if I can go to the library. Or, I sit there and do other class work." Rachel said.

Even though Rachel enjoyed having such a relaxing time in the class, she definitely was at a disadvantage. She found "some stuff that may be [from] classes that we didn't have" that were on standardized tests. She felt bad about that.

> J H: How did you feel when you took those tests (two standardized tests)? Did you like them?
>
> Rachel: No, I didn't like it. I mean it was easy. But I just don't like to take tests.
>
> J H: Maybe you have some reasons for that.
>
> Rachel: Because some stuff they ask you [is] like that went on from the first beginning of the year. Some stuff that may be [from] classes that we didn't have.

J H: So you think some questions on the test were from something you never learned?

Rachel: Yeah, some of them. But I guessed some. (Second interview with Rachel on May 22, 2001)

This Is Me: Strong and Stable Identity

Rachel enjoyed a firm and strong identity in her social world. She stayed at the center of her social world, maintaining her voice and right as the owner of her world. "This is me," she declared simply. Rachel was different from her friends, Celestina and Heather, who were immersed in their social worlds and almost lost their senses of identity and their individual voices. In contrast, Rachel preserved, and even strengthened, her strong sense of self in the world.

Rachel's identity both in school and at home was consistent. Unlike Stella, she did not feel a split in her identity as she moved back and forth between the two spheres. She hardly changed herself at school in order to be accepted or loved by teachers or her peers. Rachel said, "No! I ain't fixing to get myself... I'm just like [what] I want [to be]. I just leave the house and I come back like I am."

J H: Do you feel any difference or do you act differently when you are at home and when you are in school?

Rachel: No.

J H: No. You are acting the same in both places?

Rachel: Yeah. I act the same in both places. (First interview with Rachel on March 6, 2001)

As Rachel constructed her social world, she intentionally chose people she liked. She had a clear preference for people and hardly hid her feelings. She simply invited some, but definitely not all, of them. Kristin and Clarissa, two sixth grade African-American girls, were Rachel's best friends. Rachel's identity was deeply associated with the two girls whom she called "like twins. We're like triplets."

J H: Who is your closest friend?

Rachel: Clarissa, Holly and Kristin. We're like sisters. Like when they went on the field trip, I'm not in their class. They go [went] on a field trip in sixth period. And the lady thought they was [were] twins and they told her that they had a triplet, too. So all three of us feel like twins. I mean triplets.

J H: Triplets. That sounds great. Are you all African-American girls or…?

Rachel: (nodded) They're like me.

J H: Umm.

Rachel: I like basketball. We like to sing stuff. That's why we're close friends.

(First interview with Rachel on March 6, 2001)

Rachel was a strong leader in her social world. Her friends listened to her and respected her advice. Rachel proudly said that she was one of "the coolest black girls in sixth grade," who was able to "bring them (friends) back up when they're feeling down."

Rachel: Like you know, I tell them, like, don't worry about it. It'll wear off one day. Just enjoy life while you can. Like if they made a friend; like they've got mad at each other, then I'm like "Why are y'all mad at each other or something?" They'll be like, "I don't know." Then they'll be like, "She's right, we don't need to be mad over little stuff." Then, you know, they just get back friends and stuff. (Second interview with Rachel on May 22, 2001)

Interestingly, Rachel did not have a close friend who achieved considerably higher than her. Most of her close friends were in other regular mathematics classes or placed in SWIS or special education classes. Rachel distanced herself from other high-achieving African-American girls--the ones in the advanced class and Beta Club. She became resistant as I talked about other high-achieving students. It seemed to be a topic she did not want to know or talk about. During the first interview she brought up the Beta Club, a club of some selective students at PCMS. As I responded to her with a question about the club, Rachel changed her attitude and defensively said, "Oh, I don't know. I'm not in it. It's just the name of the club. I know they have the school outs

(field trip). That's all I know." In the following excerpt, Rachel also showed her resistance on the same topic of high achieving girls. She knew Cindy, a good math student in the advanced class, but in the end, Rachel wanted to emphasize that she treated Cindy merely as a friend, not as a person of whom she would "ask questions."

J H: Do you know any other people who are very good at math?

Rachel: Cindy Roberts.

J H: Tell me about her.

Rachel: Cindy Roberts. She always make's As. She works on her tests. She studies real good. She always makes 100s and stuff. So I think she's a good math student. Since she's a good student and everything.

J H: Why do you think that she becomes a good math student?

Rachel: Because she studies a lot. She takes half her time studying in class and stuff, and at home probably.

J H: Do you talk to her?

Rachel: Some. I mean I talk to her as friends and stuff, but not like asking questions.

(First interview with Rachel on March 6, 2001)

Rachel resisted not only the meritocratic ideology, represented by smart girls, but also feminine ideology advocated by some Caucasian girls living in their relational world. She clearly differentiated herself from others interested in "having a boyfriend." "It's what they want to do. What I'm saying, is this is me. I don't know what they want to do. It's them. Not mine. . . .(omitted sentences) I ain't fixing to get myself with no boys. I'm just like I want [to be]." To Rachel, having a boyfriend was not an issue at all. It was just a matter of time and there was no need to pay attention to that. "High school, maybe. …I don't know. That's in the future. I ain't even really thinking about it. It happens when it happens, in high school." As a result, Rachel hardly felt any pressure from boys. She never bestowed boys with any rights or power in her

social world. She saw them as trivial saying, “I ain’t got time to fool with these boys. They ain’t worth nothing these days anyway.”

Get Rich: Dreaming an Impossible Dream

There was another ideology that Rachel voluntarily subscribed to and internalized. This was the success ideology as an athlete. Gerdy (2000) and Malveaux (1997) explain that this ideology have been deeply rooted and transmitted through generations in the African-American community in the United States. Rachel confidently said that she was one of “only two sixth graders on middle school basketball team.” She treasured her identity as a good athlete. Her social world was filled with people who aspired to succeed as athletes and to “get rich.” “Yeah. Danya and Louise and Marissa, well not Marissa, but Danya and Louise, they want to play basketball, too.” Rachel knew many students playing different sports at school, and believed that they could go to college because of their athletic talents. It was so real to her and she did not want to deny the possibility. Rachel drew sports players in her mathematics notebook when she had extra time. Even when I visited her house with no accurate address, the new and tall basketball post helped me identify her house off the bumpy, unpaved, and nameless road.

J H: Tell me about your hero, the person you admire, who you want to be like in the future.

Rachel: Hmmm. A pro basketball player.

J H: OK. Do you think your friends also want to be professional sports players?

Rachel: Yep. . . . (omitted sentences) We all say that we want to make it to the pros. Get rich.

J H: Get rich! So do you think [that] playing basketball will really make you rich?

Rachel: Yes, if I make it to the NBA. That’s my goal.

J H: Is your goal to be the first woman NBA player?

Rachel: I've been playing since I was in fifth grade and I'm going all the way to college. . . . (omitting sentences) These two White twin girls, they play for ULA Hawks. They play basketball for the ULA College. University of Louisville.

(Second interview with Rachel, May 22, 2001)

Rachel had very limited knowledge of the schooling process that affects people's professional lives. She did not know anybody in her environment who had attained a well-paying, professional job based on his or her academic accomplishment. Neither did she try to expand her understanding of the system, how it might work for or against her, and how she could use it to succeed--"get rich"-- in the future. Her world was circumscribed by the people she chose to get along with, limiting her experience and understanding of school practices that were actually working against her.

Rachel was influenced by a different type of knowledge, the folk wisdom rooted in and transmitted through generations in the African-American community. As reported in Martin's recent study (2000), the negative experiences of the African-American community with the public school system in the past continued to exert their damaging influences on Rachel's perceptions of and choices in learning mathematics. Unfortunately, the majority of African-American students at PCMS were still experiencing similar discrimination and unpleasant treatment from the school, although this was now more subtle and implicit.

For example, Rachel perceived parent-teacher conferences as something negative and unnecessary. Responding to my question about PT conferences and PTO meetings each semester, Rachel said, "That's only for Beta Club." Then, she explained that having an individual conference with teachers was only "for when you get in trouble." "Not my parents," she defiantly replied, indicating she was a good student who never made her parents come to school for an uncomfortable conference with her teacher.

Rachel had little understanding of the instrumental value of learning, including the instrumental value of learning mathematics for school success and future career. Her view of

usefulness of mathematics focused on minimally required computation skills to survive at unskilled jobs. Rachel figured out that mathematics might be useful in getting into college. She had a hard time understanding how learning mathematics would help her get into college or achieve academic success at college.

J H: Why do you think we have to learn math in school?

Rachel: Hmm. Why do we have to learn it? (pause) Because later on during your career, you're going to have to know what stuff equals and stuff. So like, if you work at a cash register, you're going to have to know how much people get for change and stuff. (pause) I guess that's right.

J H: Anything else?

Rachel: Uh-uh (no). (pause) You have to count something. Like if your dog had puppies you might want to count how many it had.

J H: You already know how to count, subtract, and add. Why do you need to learn more math?

Rachel: (pause) To help you (get) in college (smiles).

J H: Tell me a little about how you knew that?

Rachel: (Giggles) In my mind. That's what I think. In college you're probably going to have a math class and if you don't go to math class in school, you ain't going to pass your math classes in college, that's so… (paused) Am I right?

(First interview with Rachel on March 6, 2001)

Despite these obstacles, Rachel wanted to go to college. She said, "My education is my day," separating herself from others who were more interested in their social lives. She believed that playing sports was the best way to achieve her two ultimate goals, going to college and "get[ting] rich." She believed that her chance to succeed on that road was great. She was one of "only two sixth graders that made the (middle school basketball) team." This was the most

important reality to which Rachel bestowed tremendous meaning. “I’ve been playing since I was in fifth grade and I’m going all the way to college,” Rachel proudly said.

However, Mrs. Oliver saw very little possibility of Rachel’s pursuing those two goals. “I don't know if she continues to be a good basketball player.” She predicted that Rachel would probably go to “either a tech school or some other schooling after high school.” Mrs. Oliver expected that Rachel would use her leadership skills to disseminate the school ideology in her community. “I feel she will be involved in twenty years, when she has her own kids, and she will tell them how important school is. And in our community. She's pretty community [minded] and real social. So I think she'll be involved in her community and what goes on around wherever she is.” In spite of this likely involvement, academic excellence was not something Mrs. Oliver expected from her. Although an agile and audacious player with the system, Rachel remained in “a comfortable zone” in which her academic endeavors were hardly encouraged as a mean of moving beyond her current achievement level. Ironically, her powerful leadership skill was merely expected to conform to the schooling system, which failed to help her recognize some feasible and perhaps more effective ways to achieve her lifetime goals—to “go to college” and “get rich.”

Amanda: Political Dissent

Amanda, one of thirteen Caucasian girls in the advanced mathematics class, always sat in the back of the classroom between two African-American girls, Brandy and Stella, and two other Caucasian girls, April and Sydney. Throughout my visit for one semester, I never observed her sitting in front or asking the teacher a question in public. She strictly limited her communications to her close friends sitting nearby. However, Amanda was not a quiet and introverted girl by any means. Rather, she was a “wild” girl when she was with her friends and family. She was the one who approached me and asked questions about my work in her mathematics class. She possessed strong curiosity desiring to explore something new while speaking and acting based upon her own

feelings and judgment. It was rather surprising to me that she was able to suppress such strong desire in the mathematics class and to present a completely different self throughout the semester.

Amanda was one of those girls experiencing early puberty compared to other sixth grade girls. She was much taller than the other girls and her body was still changing dramatically. She knew that she was not a little girl anymore but becoming a young woman. She was excited to see the freckles on her face disappearing, transforming her face from a mischievous child's to a blooming adolescent girl's. Her long and straight dark hair flowed down almost to her waist, freely moving left and right as she walked in the hall. Amanda often complained about her body getting fat and frequently skipped her lunch in order to diet. She did not recognize that she was one of the skinniest girls in the sixth grade.

Amanda's family life was rather difficult. Many years ago, her parents got divorced, and her mother received custody of her. Her mother married her current stepfather, whom Amanda never liked for many reasons. She felt that her stepfather was treating her unfairly because she had a different last name. She witnessed "a lot" of family violence that victimized her mother, the only advocate she had in the house. She saw her stepfather fanatically "yell[ing] at my mom" because "my mom tri[ed] to take up for" [her]. She could not forget the time when her stepfather "made her (Amanda's mother's) mouth bleed" and she "and my brother" had "started crying." She desperately wanted to live with her father and said, "when I'm fourteen, I can go live with him."

My Worst Class: High Anxiety

Amanda had a high level of anxiety in mathematics class. She felt "scary feelings" on the way to mathematics class. Like other participants in this study, she was worried about grades and test scores. Yet, her anxiety was more deeply related to the social and emotional aspects of the class, such as whether she could enjoy learning the subject and working with the teacher. She said, "It's [mathematics class] really my worst class," filled with all the "scary feeling, because...it's not that fun in there." She said, "it's [her grade in mathematics] actually the best

grade I get," but having a good grade did not help her love the subject. To Amanda, "hav[ing] a mean math teacher" and class that was "not-fun" were more important than getting "good grades."

> J H: What comes up in your mind when you think of mathematics? If you hear mathematics, what comes up in your mind?
>
> Amanda: Oh man, that was my worst class. It's not fun and we have a mean math teacher. (First interview with Amanda on March 8, 2001)

Amanda was also sensitive to the labeling practices prevalent in her mathematics classroom. Being embarrassed in public was something that she wanted to avoid. She did not want to ask questions in public or to be called on by the teacher. She did not expect to receive warm support from the teacher. Rather the teacher appeared to be a cold and distant authority who would "embarrass" students who were already struggling in the situation.

> Amanda: She embarrasses us sometimes, embarrasses us when we can't do a problem. She's like well, I've already taught you that, and...ugh. Like, it took ten minutes to answer a question and I got really embarrassed. She told me that I needed to know that. I couldn't help it that I didn't understand it.
>
> J H: How did you feel at that time?
>
> Amanda: Sad. Scared and embarrassed. (First interview with Amanda on March 8, 2001)

I Am Capable: Attribution Mode and Positive Identity

Despite her dramatically lower grades this year, Amanda still possessed high self-confidence in her academic potential. She emphasized that she had been a very good student, receiving only As until last year. "I told you I am capable," Amanda said in her second interview. "Teachers tell me I'm capable of it and all kinds of stuff." She confidently recollected, "She (Amanda's fifth grade teacher) thought that I was really smart, so she got me to tutor people in her class." She became "a teacher's pet" and "did the stuff she [her teacher] wanted me to do" as one of highest-achieving students in her class. Her previous experience as a successful learner

supported her confidence. She easily attributed other students' success in mathematics to their effort. In the same vein, when having a low score on a test Amanda attributed it to an unstable factor, such as her emotional disturbance during the test.

J H: Who do you think is good at math among your friends?

Amanda: Yeah. Stella is very good at math.

J H: Tell me more about her. Why do you think she's good at math?

Amanda: Well, she doesn't talk that much in class. She studies a lot, she does everything she's supposed to do, does all of her homework. And she just does a lot of math. (First interview with Amanda on March 8, 2001)

J H: Then, do you think you are unable to understand math?

Amanda: Not really. I can understand it, but I just (pause)… when it comes to a test, I guess I get so scared. (Second interview with Amanda on April 30, 2001)

Apparently, Amanda did not subscribe to various cultural myths--prevalent in American culture -- which emphasize innate ability and intelligence as determining factors in one's academic success. She believed all she needed was "just effort." However, she had a hard time exerting that effort to improve her current grades. Even though she clearly identified her problem as "too much socializing," she believed that was something natural and inevitable. "Like[ing] boys and stuff' distracted her from academic learning this year but she accepted it as something she had to go through naturally. She described that "smart girls" were "kind of like little girls" or "boy-like" because they did not pay attention to "boys and stuff." To Amanda, paying attention to "boys and stuff" was a sign of growing up and not being "little girls" anymore. Amanda accepted the change as an unavoidable process of becoming a young woman though she was aware of its negative effect on her grades.

J H: What is the most outstanding thing that happened during the last school year, your first year of middle school here.

Amanda: All my grades dropped. That was not good. Especially in science. But then I brought them up and some of the grades really changed. I think it was because I wasn't in school, I was just seeing boys and stuff. …

J H: Do you think that kind of change is natural?

Amanda: Yeah. Especially with girls.

J H: What do you mean by "especially with girls?"

Amanda: Well, girls like boys and stuff.

J H: Then, do you think boys are a little bit different from girls?

Amanda: Yeah. … Well, not really. Not really, the smart girls are kind of little girls, like boys. (Third interview with Amanda on May 24, 2001)

I Want to Go to College: Cultural and Social Capital

Amanda's family was not middle class by any means. Like half of the participants in my study, she lived in a trailer house. It took me more than thirty minutes driving around that area to find her house because it was located beyond tall bushes and trees off the paved road. There was no address. I had to shout her name several times among the three trailer houses on the lot until her mother came out and gladly greeted me from the porch of her trailer house.

Amanda's family situation was unique. Her young mother, in her early 30s, was extremely supportive of Amanda's education. She regularly visited school and volunteered as a chaperon for a field trip despite her already overloaded responsibilities as mother of four and part-time worker in a nearby city. Yet, there was a deep disagreement between Amanda's family and the school. Amanda's mother wanted school to be a more enjoyable place for her children. "I can't believe that they can't go to the restroom until lunchtime." Amanda's mother believed that PCMS had too many restrictions imposed on students. PCMS students did not have breaks between classes except a 10-minute interval between the third and fourth periods, called "locker time." This time was specifically used for students to open their lockers, put back their books and pull out other

books for the upcoming classes. Apparently that was such a short break, students hardly had time to go to the restroom until the lunch period.

Mrs. Oliver did not have a good impression of Amanda' mother and family. She remembered hardly any positive things about Amanda's mother, though she had met her several times when Amanda's mother volunteered for field trips. The only thing Mrs. Oliver remembered about her was that "she was very young."

> Amanda struggles in math. I think it is because her mother hasn't gone too far in school. I've met with her mother several times but she doesn't get the support at home where they talk about the importance of school. It's just get your homework done, you know, go on and do it. … And her mother wants her to do well, but again, I don't think that she's had that experience of how important it is. (Third interview with Mrs. Oliver on April 26, 2001)

In January, Mrs. Oliver called Amanda's mother and discussed the possibility of moving Amanda to a regular mathematics class. However, Amanda's mother knew the negative side of such a decision for her daughter. She raised her voice in order to prevent it from happening. Amanda's mother strongly believed that Amanda was able to meet the standards in the advanced class and that it was important for Amanda to stay in the class. Though Amanda was able to remain in the advanced class, Mrs. Oliver thought that was not a wise decision for her. The teacher admitted that Amanda was able to do better. Yet, she did not expect that Amanda would work harder, or that her mother would be able to monitor her daughter.

> That's her mom. She's very young. And she's come up here to have a conference at the beginning of the year. Amanda was not doing real well in math. I considered moving her out of this class, but her mother wanted her to stay in here. And I really don't know where she works or what kind of job she has. Like I said, I think she tells Amanda to do her work, but she doesn't check around behind her to see [whether] she does it. Amanda will say, "Yeah, I've done it." But she doesn't check it to say, "You missed this one" or "Let's

go over this" or "Get your book out and review this." Sometimes, that's what it takes. I don't think she gets that. (Third interview with Mrs. Oliver on April 26, 2001)

However, Amanda had been a very successful student in elementary school. That was why she was able to get into the advanced class in the first place. Though she came from a disturbed working class family, somehow she possessed a good amount of cultural capital. One of the two most visible sources of cultural capital was her older stepsister, who enjoyed teaching her younger siblings. As a result, Amanda was exposed to different types of school knowledge at an early age. By observing her sister's path through the schooling system, she had a chance to eavesdrop on what she was learning in a higher grade. Amanda learned what she could expect in a few years. Her stepsister was also a good instructional resource at home. Therefore, it was not surprising that Amanda possessed a good amount of cultural capital, which, on the surface, seemed not readily available to her based upon her family's socioeconomic status.

Amanda was well aware of the high expectations and support given to students in a higher stream, and the benefits of belonging to the high stream throughout the school years. She clearly knew that was an important part for school success. As a result, she desired to get into the pre-algebra class next year, though she knew that she was not achieving high enough to get in to the class. Her eyes were wide-open clearly seeing the end of each stream and all the benefits and shortcomings located on each road.

Amanda: I hope that I pass with a [good] grade because I want to take Algebra I. My mama doesn't really want me to take it that much because she thinks it's going to be too hard on me. But I really want to take it. But I know, if I can't be in it next year that I'm going to be in it in eighth grade because that's what they teach. And if I'm in eighth grade and I...I've already taken algebra I, I'll be in Algebra II. So I'll be ahead of what I'm supposed to learn.

J H: How did you know all that kind of things?

> Amanda: My sister, we used to play school a lot and she'd tell me about what they did and like positive and negative. We learned about positives and negatives today. And she told me that when I was in like 3rd grade. (Third interview with Amanda on May 24, 2001)

Another important source of cultural capital in Amanda's life was her teachers. Amanda enjoyed a strong relationship with her teachers in elementary school. To Amanda, having a good relationship with teachers was important, an essential part of her achievement motivation. During her elementary school years, she easily identified herself with her teachers. She maintained an intimate relationship, full of social and emotional support, with her teachers, and securely nested her academic success within that social and interpersonal context. Since she entered middle school, however, she found everything had changed dramatically. She could not find a teacher with whom she could identify. Seemingly uninterested in schoolwork, Amanda desperately longed for a teacher with whom she could established such a relationship. She wanted somebody who would recognize her talent and potential, and ignite her motivation to learn. Amanda treasured a word from her language art teacher, Mrs. Thomson, who expressed higher expectations of her schoolwork.

> I still did my work and stuff. I just (pause) I don't know, … I didn't study enough and I didn't ever get the grades I should have got. Like our teacher, Mrs. Thomson, she was telling about students and she was talking about me. She said that she knew I could do better (but) I just didn't show it. And that made me think and so I'm thinking I'm going to get my grades better. (Second interview with Amanda, April 30, 2001)

On the other hand, Amanda had a good understanding of the instrumental value of learning mathematics. Her understanding about the use of mathematics was almost the same as that of middle class participants. She clearly knew that learning mathematics had a good instrumental value in her future career. She said, "See, Everybody in my family want[ed] to go to college" but

once they took “a job, forgot about it.” However, Amanda did not want to be like them. She firmly stated, “I want to be the one in my family that goes to college.”

> J H: Do you think math is important? Honestly, do you think learning math is important, in your life?
>
> Amanda: Very important. Because if you have to get a job, if you're doing it on a computer like at the bank you have to add up all this kind of money. And if you don't know how to add, then you're probably going to get it wrong. Then you're not going to have a good job.
>
> J H: Is there any other reason that makes you or that makes other people learn mathematics at school?
>
> Amanda: Well, a reason why we need to learn it is because we need to graduate, we need to go to college. If you're going to (pause) college, they have to really know how to do math to get a scholarship. (First interview with Amanda on March 8, 2001)

Amanda’s understanding of the importance of mathematics and schoolwork was not much different from that of high-achieving middle class girls. What was absent in Amanda’s world, was the clique of “snobby smarties,” with whom she could construct her positive academic identity. However, Amanda had friends who suffered from high anxiety and deep self-alienation in the mathematics classroom. Amanda formed a strong tie with African-American girls who were already marginalized in the space. Her association with Stella and Brandy became stronger throughout the semester. April, another Caucasian girl from a disturbed family background, soon joined the group. In the group, they shared something important--mutual support and care, which seemed otherwise unavailable to them in the classroom. The group functioned like an emotional and social safety net they could trust and rely on.

I Have Doubts: Emergence of Critical Consciousness

Amanda was a girl who had a strong voice that sprang from deep in her heart. She was not afraid to disagree once she found something was not right. She had a very strong sense of self,

and trusted her own judgment. She did not readily accept things as natural and legitimate. She developed a critical consciousness to examine the reality surrounding her and the people she cared for.

Amanda's critical consciousness stemmed from her own lived experience, living in an insecure and violent family environment. She knew that she was not a beloved member of the family. Her stepfather treated her unfairly. What disturbed Amanda most was her stepfather's repeated violence that victimized her mother, her only advocate in the family. Several times she witnessed her mother verbally and physically abused by her stepfather because her mother was "try[ing] to take up for me." She bitterly recollected the scene when her stepfather "made her[mother] mouth start bleeding" and "me and my brother" "started crying." Amanda did not believe that her stepfather really loved her mother. "I have doubts," said Amanda. Neither did she understand why her mother did not want to talk about her husband's violence and leave him. "I told her [her mother] to leave but she doesn't want to leave." Amanda stepped up as an advocate for her mother and tried to find a solution that could stop the violence against her mother. From this experience, Amanda learned two important things: To her, not everything in the world was absolutely right and legitimate. She realized everybody had to choose their own action considering what would benefit them and others who were involved in the situation. She also learned how important it is to care about and respect people no matter their status or power in their mutually shared world. She repeated "a nice person" and a person who "doesn't hurt people" when describing a desirable relationship in her future.

Amanda possessed strong subjective knowledge that she had acquired from her own lived experience (Belenky et al., 1997). She did not blindly accept the manifested school ideology, but carefully examined its value and coherence as she experienced it. She questioned everything. The school and teachers might not be as fair and just as propagandized. Her critical consciousness did not allow her to simply conform to given ideology and practices, in which she sensed incoherence that she could not accept as natural and unproblematic. She knew that they hurt people, in many

cases the weakest and most vulnerable people in the system. Having experienced family violence, Amanda developed an ability to grasp and tell what was more important in the shared world of many people, including her. She did not want to give up her independent voice, her ability to judge right from wrong.

Amanda's experience with her mathematics teacher was very negative. Mrs. Oliver believed that Amanda was "not doing as much as she could do." "She is not concerned about it," said Mrs. Oliver. The teacher did not understand Amanda's attitude toward learning: "She's capable, [but] she just doesn't do it." To Mrs. Oliver, who strongly believed in hard work, Amanda's carefree attitude was very frustrating. When describing Amanda's work in her class, Mrs. Oliver focused on Amanda's attitude rather than her ability or potential. "She's more interested in social things and what her friends are doing. She has a lot of friends in this class. They sit around over there and more interested in what this boy's doing or who's going with who. . . (paused) She's just at that age where this [math] is not all that important." Surprisingly, Mrs. Oliver expected very little of Amanda' future career. "She'll probably get a job at Wal-Mart or somewhere like that. Or get married and stay home for as long as she can, if they can financially swing it. And then she'll just get a . . .(paused) I look for her probably to get just a standard pay job, nothing professional."

Basically, Mrs. Oliver believed that Amanda needed close monitoring and supervision from an adult. She strictly applied her classroom rules to Amanda as she did to many other students who came from lower socioeconomic backgrounds. Mrs. Oliver doubted if Amanda's family could really support her learning. She did not see any possibility that Amanda would make it through. Therefore, the only thing Mrs. Oliver thought she could do for Amanda was force her to follow, and hopefully embody, the strict rules in her class so that she would discipline her for a very slight chance of academic success in the following grade.

However, Amanda saw the situation differently. To her, effective and comfortable learning could not take place unless she had a warm and mutually respectful relationship with the teacher.

Being forced to participate in learning without such an interpersonal base made her hate mathematics and the teacher. Furthermore, Amanda possessed critical consciousness that actively examined the value and legitimacy of many practices and relationships existing at the school. She did not assume that teachers were all right and everything at the school was necessary. She was different from students who easily took everything for granted without question or doubt. She had already developed crystal clear eyes penetrating the discrepancy, absurdity, and immorality of many school practices. She was a girl possessing a strong inner voice to tell right from wrong. This voice could not be easily suppressed or eradicated by outside pressure. Amanda described several incidents when Mrs. Oliver applied the classroom rules more stringently to her. Amanda believed that the teacher's action was biased because the teacher intentionally ignored the contextual information that needed to be considered before punishing a student.

J H: Could you explain why you had it (lunch detention) and how it went through?

Amanda: Well, I was out one day and I told her that I didn't do my work sheet. And she said, well, you're just gonna have to go to lunch detention and you're going to have to copy questions from it and you have to do it. I told my mom about that and she didn't like it that much because I couldn't help it that I was sick. She should have given me some time to make it up.

J H: Hmmm. Then, didn't your teacher give you time to make that up?

Amanda: No, she didn't. She wouldn't even give me a work sheet and she wouldn't let me copy it until lunch detention on Wednesday.

J H: Is it common to other students when they are sick?

Amanda: Well, sometimes. But usually she'll give them their work sheet. I don't think she likes me that much.

J H: Why do you think she doesn't like you that much?

Amanda: I don't know. I just can't understand math like she wants me to understand it or something. And I don't make [such] good grades. She might think that. (Second Interview with Amanda on April, 30, 2001)

Amanda reported several incidents when the teacher was "hollering at us" and "made me scared to death." "I thought she was really mean," said Amanda. Even though Amanda herself was not the victim of the teacher's unfair treatment, she showed deep compassion toward the student troubled in the situation. Amanda knew that the teacher tended to treat "smart children" better than others, but also noticed not all smart children received her special treatment either.

J H: Then tell me more about how she is treating her students differently.

Amanda: She likes um...smarter children, all right, Stella, Sydney, and Janet. She does not let us go to the restroom at all. And if you ask to go to the restroom, she'll say, "No, you should have gone earlier." But if they ('smarter children") go ask her, she'll say yeah.

J H: Can you remember a time when that really happened?

Amanda: Stella went to ask to go to the restroom and then Mrs. Oliver said, "You should have gone earlier." Then Janet went to ask her if she could go to the restroom and Mrs. Oliver let her. I don't think that's fair. Because Stella, she's really good in the class. (Third interview with Amanda on May 24, 2002)

You Can Learn in a Different Way: Call for Respect

The teacher's differential treatment was not the only reason for Amanda to dislike mathematics. Amanda also found that she could not enjoy the teacher's authoritative way of teaching mathematics. She believed there could be more than one way to learn and understand something. She hoped that different ways of learning and understanding could be accepted and valued in the mathematics class. However, that was not something she expected in her class.

J H: Have you ever thought about a better way to learn it? For example, I want my teacher to teach this content in a different way.

Amanda: Well, sometimes she just says, "OK, this is how you're going to do this." And we tell her a different way, she's like… April C, her aunt is a teacher and she told her that her aunt taught her differently. And Ms. Oliver said well, "That's just my way. This is the way I'm going to teach it."

J H: So, um, tell me about that time when April was explaining another way to solve the problem. The teacher looked like she didn't like it?

Amanda: Hmmm (yes). She was mean. She just said, "This is the way I'm doing it and this is the way I'm going to do it and this is the way you're going to learn it." …. (but) I think it's better if you can learn in a different way that you can learn and understand better. (Second interview with Amanda on April 30, 2001)

In some cases, Amanda expressed her desire to reach a deeper level of understanding, more than a simple memorization of formulas and plugging numbers into those formulas. She wanted to "understand" the meaning of formulas and why they worked.

J H: Tell me about the most difficult part you learned during the last month.

Amanda: Hmmm (thinking). When we had to do the volume and the area. The volume is really hard to remember, like LWH. I couldn't remember all these things. The V equals something. A equals something. It was just hard to understand. (Second interview with Amanda on April 30, 2001)

Another thing that Amanda did not like about her mathematics class was the lonely and repetitive work that she had to perform everyday. She also suffered from a high level of anxiety. Individual and competitive work was not something she could enjoy in the space. Amanda liked working in a group or in pairs. The reason was simple. "If we don't understand something, we can get help from them." Amanda wanted a safety net.

J H: Do you have any specific situation that makes you turn away from math?

Amanda: Sometimes. Because we have to do a lot of homework. And I'm

like, we have to do a lot of homework, I just don't like math. It's just so stupid. But it's not really stupid. It's just because we have a lot of work to do.

J H: Have you ever thought about why you have to do such a lot of homework?

Amanda: Well, if we don't understand anything she usually makes us do a lot of it. And sometimes we need to do a lot of it. But sometimes we really don't. (First interview with Amanda on March 8, 2001)

J H: [Tell me about] the most boring class that you had.

Amanda: Well, when we had to look through our book and deal with the stuff. That wasn't that easy because you just had to look up the stuff. (in very depressed voice) Because you have to do it yourself. And you didn't have anybody to help you. And that, it could be like ask you a question and you can't answer it. You just had to do it by yourself. (Second interview with Amanda on April 30, 2001)

You Shouldn't Be Treating People Like That: Advocating an Ethic of Care

Seemingly uninterested in any schoolwork, Amanda turned out to be one of the most vocal girls criticizing the repressive culture of her mathematics classroom and various hurtful practices within the school. She became rebellious when she witnessed the broken human relationships between teachers and students, which revealed there was no mutual understanding or responsibility of caring from either side.

Amanda: Well, last year people told me that she was a mean math teacher. And she kind of looks mean, but I kind of like, I hope that she likes me. And I hope that I don't do bad in her class. She was ok when I first met her, but then it was not that good.

J H: What made you change your thought about her?

Amanda: Well, when she started hollering at kids and stuff.

J H: Hollering? What do you mean by that?

Amanda: Well, if somebody couldn't understand something, then she'd get mad at them and started yelling at them. (Second interview with Amanda on March 30, 2001)

Amanda criticized her mathematics teacher, as well as other teachers, because they threw away their moral responsibility to care about students' feelings. Her mathematics teacher, from Amanda's perspective, had broken the rule of caring, which was central to her relational world especially when students were vulnerable, helpless, and most in need.

It was interesting to see that Amanda moved beyond her own negative experience with the teacher and formed a collective identity with other students who were also victimized in the classroom. She started talking not only about herself, but also about others who were vulnerable and hurt in the space. Amanda's effort to make sense of her own experiences led her to a sense of community with others who had similar experiences. In some respects, this process echoes Gutierrez's new interpretation of Job within the tradition of Liberation Theology in Latin America (Gutierrez, 1990). To Amanda, identifying herself with other "innocents" in distress and pain enabled her to see the common problem more clearly. (Gutierrez, 1990). Therefore, even when the teacher's justice principle was directed toward someone else, Amanda felt distressed and angry. Her understanding of other people expanded as she felt a deep compassion toward "them" at whom the teacher was "yelling." She released her anger from her limited and self-focused experience: It was becoming a collective experience as she related herself with many other students struggling with the justice principle in the class. In the following excerpt, Amanda used "people," "I," and "we" interchangeably reflecting her resistance was not only individual, but based on collective experience of "we." "You shouldn't be treating people like that," Amanda cried.

J H: Tell me about what you don't like about math.

Amanda: I don't like when she yells at *people* and I really don't like that. And I don't like when she embarrasses *people*. Like say, *I* got a problem wrong and she'd get mad and say

that she's already taught *us* that (and) *we* should know it. And I really don't like when she does that.

J H: How do you feel when she says that kind of thing to students?

Amanda: I feel mad. I'm like well, you shouldn't be treating *people* like that.

J H: Do you think the other students feel the same way?

Amanda: Yeah. Because students will tell me that, she was yelling at *us* today and stuff like that. (emphases added) (Second interview with Amanda on April 30, 2001)

Amanda gave up trying to like the teacher. Soon after, her grades plunged. To her, the culture of her mathematics classroom, including how the teacher and smart people acted, was not compatible with her beliefs, the principles of caring and mutual responsibility, in her world. Amanda thought the mathematics classroom was a place for people like Jessica, who were irresponsible and indifferent about others, not for her. In the third interview, Amanda said, "Math is not important." She refused to learn mathematics and attached no value to mastering the subject. Her skepticism was fundamental because it arose from a clash between her commitment to the ethic of care and the impersonal, justice-based culture of her mathematics classroom. Her counter ideology was deeply ingrained in her consciousness and was incompatible with the culture of school mathematics she experienced.

Amanda needed more than the instrumental value of school mathematics to reorient herself toward mathematics learning. However, the ideology and the reasons provided by the teacher and the school hardly answered her deep-seated question. Once an "all A" student, Amanda cautiously observed and evaluated the people in her mathematics classroom, wondering and questioning how they could just ignore such important ethics and go on with their lives so easily, without pain or regret.

Summary

Each of the five participants in this study presented a unique portrait of herself, revealing the complexity and dynamics of gender issues in mathematics education. Even though they

shared the same mathematics teacher and school environment, their experiences with school mathematics differed significantly. The girls expressed contrasting perceptions of and attitudes toward the teacher, mathematics learning, and school in general. (see Appendix H)

Jessica, a girl from a White middle-class family, felt less difficulty in embodying the "habitus" (see Appendix G for definition) of mathematical learning that prevailed in the mathematics classroom (Bourdieu & Passeron, 1990, p.31-32; Postone, Lipuma, & Calhoun, 1993, p. 4). Her social world, consisting mainly of friends and family, provided her with a cultural context similar to that of the mathematics classroom. As a result, she easily adopted the various school-related ideologies, such as the instrumental value of mathematics and "fair-school ideology," and embodied the attitudes that helped her advance toward school success. Jessica gradually separated herself from "others who don't like mathematics and don't care about school," successfully constructing her positive and confident identity in the domain of mathematics.

In contrast, Stella, an African-American student from a working class family, experienced a deep division between her social world, which consisted of her core and extended family plus her African-American friends--who shared her cultural heritage and ethnic identity--and the world of school mathematics. Stella sensed that the two worlds did not fit each other. Even though she was one of the top students in the advanced mathematics class, she was troubled, feeling a deep alienation in the classroom. Exposed to conflicting messages from the two worlds, Stella was confused. It was hard for her to embody the habitus of learning school mathematics, which was separated, competitive, and instrumental, because it seemed so alien to her own culture. As she tried to reconcile the conflicting values of her two worlds -- that of her teachers/school and that of her friends/ethnic group -- Stella faced a crisis in formulating her own attitude toward learning mathematics. The fracture between her worlds was tearing her apart inside.

Celestina, the only Hispanic participant in this study, also experienced a high level of stress in her mathematics class. Her anxiety was derived not only from the cultural characteristics

of her mathematics classroom but also from her family's constant pressure regarding her low grades. Celestina held a genetic view of intelligence and believed that she simply did not have "the brain" required to learn. Helplessness and lack of agency characterized her overall experiences with school mathematics. Situated in the middle of the prevailing meritocratic ideology and her own conviction that intelligence was genetic, she resorted to a feminine ideology to restore her sense of self-worth. Her subscription to this feminine ideology had twofold consequences. On the one hand, the ideology provided her with power in her social world. She frequently used it to counterattack the "smart" girls who often hurt her feelings at school. On the other hand, feminine ideology made her extremely vulnerable to the critical eyes of others, especially boys. Celestina perceived her mathematics class as an unsafe place in which people, including boys, constantly tried to embarrass her. She wanted to move to a lower class in order to escape from such discomforting gazes and repeated embarrassments.

Rachel, an outspoken African-American girl in the regular math class, did not suffer from anxiety like others from ethnic and class backgrounds similar to hers. She was clearly a leader among her African-American peers at PCMS. Unafraid of her teachers, she also recognized the difference between situations that could be favorably negotiated and those that demanded really "ugly" confrontation. Rachel and Mrs. Oliver had a positive relationship based on a mutual respect for each other's authorities at the school.

Rachel was extremely confident in mathematics, considering herself an "A student." She tended to evaluate her level of achievement according to her relatively strong performance within the regular math class. However, she did not consider advanced classes as a realistic option or something she needed to pursue. Rather, she compared her mathematics achievement with that of other African-American students in remedial classes. Equally significant, Mrs. Oliver also held no higher expectations for Rachel.

Rachel preserved her own strong voice, rejecting both feminine and meritocratic ideologies. Yet, she embraced another ideology: success through athletic talents. She aspired to

"get rich" as a successful pro-basketball player, firmly believing that she could "get into college" and "get rich" because she was an outstanding athlete at PCMS. This was a powerful ideology that supported her positive identity and led her to dismiss other competing discourses at the school. In her view, her ultimate success was more attainable in the world of sports than in any other domain. Academic work, including mathematics, did not seem to be the path to her future success.

Amanda, a White girl from a disturbed working class family, voiced her wish that mathematics learning should or could be something more than what she experienced in the classroom. Despite her family's low socioeconomic background, Amanda possessed the cultural knowledge of how school worked for or against each student. Also, she had a high degree of confidence in her potential to become a good mathematics student. Yet, the instrumental value of learning that prevailed in her current classroom was not sufficient reason for Amanda to like mathematics. She longed for an environment in which she could comfortably relate to the teacher and enjoy the learning process itself.

Drawing on her traumatic experiences at home, Amanda paid close attention to the relational aspects of her mathematics classroom. When she recognized incoherent school practices and broken human relationships in class, she developed her critical voice. Amanda deeply doubted the fair-school ideology and the justice principle strictly practiced in her mathematics classroom. To counteract them, she expanded an ethic of care as the primary principle in the classroom --ensuring that the most vulnerable students are protected and receive the special support they deserve.

CHAPTER 7

CONCLUSION

The findings of this study reconfirm the thesis in the literature of mathematics education suggesting the complexity of gender issues in this discipline. As a whole, this study demonstrates that the participating students' experiences with school mathematics were grounded in the cultural characteristics of their mathematics classroom, which emphasized separate, procedural, individual, and competitive work. The students' SES backgrounds and ethnicities, and the characteristics of the peer groups they belonged to, were other important factors that created a significant variation across the five students' profiles. Yet, each student's perceived agency in her own learning, and the types of ideologies she unconsciously or intentionally subscribed to, were important constituents of her attitude toward school mathematics and her motivation to learn. The girls participating in this study continually exerted their effort to better understand or interpret their lived experiences with school mathematics. In that process, they adopted, connected, and expanded some ideas and ideologies available to them while resisting others in order to defend their own choices and actions in and out of the mathematics classroom.

Impact of the Historical and Community Context

This study poignantly revealed the negative facet of a public school that has not freed itself from the yoke of the past. Administrators and teachers at PCMS remained imprisoned in their own philosophy of class, race, and gender blind justice. Ironically, this was the very philosophy that had brought racial integration to the schools thirty years ago despite the White community's resistance. To PCMS teachers, the philosophy still represented an ideal, progressive manifestation advocating the educational rights of ethnic minority students. After more than thirty years of racial integration at the school, these teachers were still fighting the remnants of the gloomy past:

they had little sense of urgent new challenges posed by another type of injustice existing within their school practices that continued to marginalize minority students. In Pine County, the economic disparity between the White community and the African-American community largely remained. In fact, the recent influx of White professionals from an adjacent city increased this disparity. When the school functioned to favor students from middle-class backgrounds, ethnic minority students, particularly African-Americans, constituted the majority of victims because most of them came from working or under class family backgrounds.

The Teacher and the Mathematics Classroom

Mrs. Oliver, a self-confident and hard-working mathematics teacher at PCMS, revealed several challenges that many rural and even urban teachers may share in their everyday lives. First, despite her enthusiastic commitment and continuing effort to serve her students, Mrs. Oliver's professional development as a middle school mathematics teacher was isolated from the professional communities of mathematics teachers and researchers. As a result, she conceived of mathematics as static knowledge and adhered to a somewhat traditional mode of instruction: authoritative, procedural, and individual work-based (Ball, 1990; Brown, McNamara, Hanley, & Jones, 1999). Mrs. Oliver often limited the number of possible answers for a given problem. Mrs. Oliver divided the entire process of problem solving into several steps and constantly emphasized those steps. She hardly used cooperative learning strategies in her classroom. The traditional view of mathematics and the procedures used in teaching the subject have been widely documented in mathematics education literature (Boaler, 1996; National Council of Teachers of Mathematics; 1989, 1991, 1995, 2000). Many reforms in mathematics education have sought to change these long-standing conceptions about mathematics and methods of teaching it. Unfortunately, however, this conception is still prevalent among mathematics educators even after a number of reform efforts to change both teachers' beliefs and instruction.

Mrs. Oliver felt huge pressure from the accountability issues prevalent in the public discourse. She believed that some current educational reforms did not respect the professional

judgment of teachers who actually know what their students need to learn at a particular time. She believed that different groups of students had different educational needs, and that no curriculum fit everybody. Also, she regretted that the state-mandated curriculum and repeated standardized tests jumbled her mathematics curriculum, preventing her from delivering the ideal instruction she genuinely wanted.

The fundamental ground of Mrs. Oliver's strict disciplinarian approach to teaching was the "fair-school ideology." She never questioned the idea that school was fair and that all people readily agree, or should agree, on the value of education no matter what background they come from. This explains why she was often frustrated with students and their parents who seemed not to share her point of view. Some students from a White middle-class background interpreted her strict and firm attitude as an expression of high expectations for their academic success. These students shared the same assumption—school is fair—with Mrs. Oliver and easily identified themselves with their teacher. In contrast, ethnic minority students and those from a working-class background who deeply doubted the "fair school" ideology experienced her strict disciplinarian approach very differently. They viewed her firm attitude and strict rules as something that could hurt them at any time—because school was *not* fair to them and teachers treated them differently. These students felt uncomfortable and insecure in Mrs. Oliver's classroom. When she tried to help them "work and learn" by using the rules and reward/punishment system, they did not feel it was just.

Unfortunately, it was difficult for Mrs. Oliver to accept the fact that those students' deep doubts and critical views of the school and teachers were grounded in their lived experiences at the school. Also, she found it hard to recognize that the fair school ideology and the ethic of hard work were more easily shared by "privileged" people in society than by those from marginal groups. Mrs. Oliver's ideological stance affected her assessment of each student's potential for learning mathematics and, in consequence, determined her interactions with the particular student.

It is not surprising that a teacher's expectations of and interaction with students are affected by on his/her perceptions of the students' SES or ethnic backgrounds (Atweh et al., 1996). A more interesting finding from this study was that although such relationships are sometimes direct, at other times the teacher's and student's shared ideological stance mediates the relationship. For example, not all White middle-class students in Mrs. Oliver's classes interpreted their teacher's strictness as an expression of high expectations and implicit respect for their abilities. In the same vein, Mrs. Oliver did not provide her special support to all of her White middle-class students. In general, she tended to overestimate the mathematical competence of those White students who seemed to embody the ethic of hard work and overlook the potential of other White students who did not. Students who did not accept the fair school ideology and an ethic of hard work were not allowed to enter her world of caring, whether they were from middle-class families or not. However, in her mathematics classes there wasn't a single ethnic minority or working-class student whom she perceived as a "hard worker" and therefore worthy of special support and encouragement. Apparently, Stella and Brandy were hard-working students, but she perceived them as passive learners rather than active and promising achievers.

In Mrs. Oliver's classroom, gender differences in student behaviors, including their interactions with the teacher, largely confirmed the previous findings reported in mathematics education literature. Boys tended to dominate the public discourse, particularly when a question was thrown to the entire class and the answer was not clear to them (Becker, 1981; Hart, 1989). During group work, boys tended to argue for their answers as the right one, while girls were more likely to check their answers again before they asserted that theirs were correct. Interestingly, some boys in Mrs. Oliver's class seemed to enjoy the competitive work and focused on the speed rather than the quality of their job (Boaler, 1997; Fennema & Peterson, 1987). Mrs. Oliver's attitude toward gender issues in mathematics was also ambivalent. Even though she maintained that her female students were as capable of learning mathematics as her male students, she often

attributed the girls' success to their effort and hard work. In contrast, she seemed to assume that boys understood her instructions more easily than girls did (Leder, 1992; Li, 1999).

Reproduction Through Social and Cultural Capital

Class was the most identifiable sociocultural factor that exerted a profound impact on both the teacher's and her students' experiences with school mathematics and each other. Jessica, who came from higher SES, felt less difficulty in embodying the "habitus" (Bourdieu & Passeron, p. 31-32; Postone, Lipuma, & Calhoun, 1993, p. 4) of mathematical learning prevalent in the mathematics classroom. Her social world, with significant support from friends and family, provided her with a cultural context similar to that of the mathematics classroom. She readily adopted the fair school ideologies, such as the instrumental value of mathematics, and embodied the attitudes that facilitated her move toward school success. Gradually, she separated herself from "others who don't like mathematics and don't care about school," successfully constructing her self-confidence and motivation in the domain of mathematics.

In contrast, girls from marginalized ethic and class backgrounds were experiencing a much deeper confusion between their social spheres and the world of school mathematics. These two worlds appeared to be irreconcilable. The extremely high levels of anxiety and depression Stella and Amanda experienced in their mathematics class reflected this fracture between their two different worlds. In Stella's case, her ethnic identity was the central axis that prevented her from adopting a non-critical and conformist view of school ideology. She grasped the fact that her genuine personality, grounded in cultural values and behavioral codes different from those of the White community, was not appreciated at the school, where her brother, cousins, close friends, and sometimes she herself were treated unfairly. As a result, she constantly veered back and forth between her two worlds, bringing to each her apparently contradictory desires, one for school success and the other for solid ethnic identity.

In Amanda's case, a working class White girl, the influence of class emerged more clearly. Her and her mother's experiences with school and the math teacher were based primarily on the

class factor, as were the teacher's perceptions of and interactions with Amanda and her mother. Amanda's critical consciousness and her intentional elaboration of an ethic of care as the fundamental rule in the classroom arose from her traumatic experiences in a disturbed working-class family. Amanda was deeply doubtful about events occurring around her and sensitive to injustices widely accepted at the school. She had a mental construct of an ideal world and positive relationships that everybody needed to pursue, and this prevented her from becoming a "conforming girl" in her mathematics class.

These two girls from the sociocultural margin, even though they were among the smartest students in the class, were troubled, feeling a deep alienation in their mathematics classes. Both were exposed to different messages from their two worlds and felt confused and frustrated. It was hard for these girls to embody the "habitus" of the separated, competitive, and instrumental way of learning prevalent in their mathematics classroom. Neither had been exposed to the cultural ideology that White middle-class students naturally absorbed from their families and friends. Instead, they deeply doubted the value of such attitudes and posed fundamental questions about an ideal human relationship in the classroom. Clearly, girls from marginalized backgrounds required more cogent and persuasive reasons than girls from the "mainstream" culture, because committing themselves to learning mathematics was not a simple issue to them. It was, instead, an existential choice between their two different worlds, requiring them to place themselves intentionally in a difficult, uncomfortable situation for a possibly valid − but still obscure − reason.

Rachel, an African-American participant from a working class family, shows another path often voluntarily taken by many marginalized students in the United States. Simply, Rachel did not consider academic success as her goal. Rachel's indifference in academic success was circumscribed by the negative school experiences that African-American community had, and, in many cases, still have on an everyday basis: her strong belief in athletic success reflects the bitter wisdom handed down in the community, seemingly the only possible way to "get rich" for them.

Rachel intentionally limited her interactions with high-achieving girls, either White or African-American, and trivialized the influences of meritocratic ideology. Instead, she focused on athletic success, which, in fact, is a more competitive path, with a much higher attrition rate, than the other way, academic success. Unfortunately, Rachel's conscious choice and active participation in athletic activities seem to contribute to the existing reproduction cycle leaving her with little chance to achieve her ultimate goals—to get in to college and get rich—in the future.

However, the impact of class apparent in this study was a much more complicated process than seamless reproduction, and involved various unexpected factors. For example, Amanda, though from a working-class family, clearly absorbed considerable knowledge of the educational system from her elder stepsister. Throughout her elementary school years, Amanda maintained a very positive relationship with her teachers, enjoying social support for her achievement. During this study, she was still longing to meet anther teacher who would support her academic efforts at the school. Intuitively, she knew that without that support she would not be able to bring up her grades to their earlier levels.

Celestina was an exceptional case in terms of the impact of class on student motivation and achievement in mathematics. The child of an assimilated Hispanic family, she did not develop a strong ethnic identity. She was always associated with White girls, most of them from a middle-class background similar to hers. Yet, Celestina did not appreciate the meritocratic ideology advocated by her family and her school. She believed that an individual's intellectual capacity was innate and that she did not have the aptitude required for academic success. Therefore, she felt that she had little agency in her own learning. Rather than exerting more effort to meet her family's expectations, Celestina chose the feminine ideology to preserve her self-worth and relational power in her peer group. As a result, the impact of class, in her case, was not a determining factor: it simply made her long to "get good grades so bad" without exerting a significant amount of effort, or complain about her brain, which she believed prevented her from getting good grades.

Two Sides of a Conformist View of the World

Jessica, the successful mathematics student in this study, reveals two contrasting aspects of a conformist view of the world. First, she effectively counteracted the negative influences of the feminine ideology, which has often been identified as one of the most serious obstacles in girls' success in mathematics. Jessica did not view mathematics as a male domain; nor did she suffer from the cultural myths that negated girls' potential for learning mathematics. Her success came naturally, without compromising her femininity. As a whole, Jessica used the prevalent meritocratic ideology to counterattack the negative influences from feminine ideology and other myths that might have worked against her academic success. Her meritocratic ideology was closely connected to her strong sense of agency, her incremental view of intelligence, and her belief in the importance of hard work in achieving her future dreams.

However, there was one disturbing aspect of her conformist viewpoint. Mrs. Oliver often praised Jessica (and other conformist students) for "doing everything I asked her to do." Responding to such expectations, Jessica internalized a strong conformist perspective on learning, which resulted in a powerful, even blind, instrumental rationality in her consciousness. Without acknowledging what they were actually planting in the minds of young students, educators often contributed to the gloomy history of instrumental reason as criticized by early critical theorists (Horkheimer & Adorno, 1945/1972). Horkheimer and Adorno explained that overpowering instrumental rationality in modern society led the majority of German professionals to participate in the Holocaust without critically questioning the meanings and values of their work. The tyranny of instrumental reason is born and expands when teachers encourage students to obediently follow rules and established cultural codes while suppressing their desire to critically examine the legitimacy and coherence of the world as they experience it. Raising a person filled with the formidable power of "instrumental rationality" (Hollinger, 1994, p. 84) could be viewed as a tragic consequence for which modern education was partly responsible. More important, this kind of educational discourse, focusing on the instrumental value of learning, still exerts its

formidable power in many sectors of education today. Media, policy makers, and educators concur in extolling this value and tend to ignore the negative side of such educational discourse. Yet, what history clearly teaches us is that these forces can strangle our own future, even without our knowing it, if we do not restrict the power of instrumental rationality and put it in perspective in our young generation's value system.

Girls' Different Way of Learning

The majority of girls in this study could not eagerly commit themselves to the presentation of school mathematics in their classrooms. They described their mathematics classes as "confusing," "scary," and "too harsh" for their comfort. The teacher's authoritative and procedural way of teaching mathematics suppressed their desire to express their own ideas and to pursue a more meaningful understanding of the content in relation to their larger world. They found the extensive individual and repetitive work without relevant contextual understanding almost unbearable. The "piece of knowledge" presented in the classroom hardly made any sense in their lived world.

Furthermore, the majority of my student participants found it impossible to enjoy the extreme form of meritocracy so deeply embedded in school mathematics. Winning in competition and achieving a superior label at the expense of others' feelings were not an attractive incentive to them. In their relational world, caring was as important as individual excellence, and blind justice was not the best way to encourage genuine, meaningful learning. Rather, they viewed participating in those competitive practices as a sign of immorality and abandonment of mutual responsibility in the shared world. Not surprisingly, they were reluctant to enter the arena of competition, hoping for something else, something more humane, "right," and intelligible to them. The tendency of the girls in this study was not new; in fact, it has been noted frequently in mathematics literature during the last few decades (Boaler, 1997; Sassen, 1980).

> Their structure of knowing is more oriented toward preserving and fostering relationships than toward winning . . . . (W)omen bring a relational, contextual structure of knowing to

the cue they are asked to make sense of, and thus find they cannot accommodate it to this kind of competitive success. (Sassen, 1980, p.19)

One important question remaining to us here is how to interpret the meaning of this fundamental difference in many, though not all, girls' approach to learning mathematics. Simply encouraging girls to learn more mathematics seems not to be the best answer as we speculate on the findings of this study. Rather, I found that voices of resistance project a degree of hope that I could not identify in more conformist voices. As Jungwirth (1993) suggests, girls' subjective interpretation of mathematical learning should be a starting point for critical analysis of gender issues in mathematics education. Educators need to move beyond the simple acknowledgment of girls' different approaches to learning, or the mere modification of current instructional strategies to help female students learn more effectively. I believe that findings from this study can develop into a more profound cultural criticism of the ways patriarchal society has structured the discipline within a larger sociocultural context. Jungwirth (1993) argues:

Maybe there are different approaches to mathematics, different ways to experience mathematics as meaningful, and different aspects of mathematics that make or do not make sense; and maybe mainly those ways are ignored and those aspects are emphasized in the mathematics classroom that make female students rather than male students feel uncomfortable because of a lack of meaning. To turn away from mathematics in this view would be a decision of females who make fruitless efforts to create meanings out of what is going on. They would not be victims of gender-role expectation; they would like to live in worlds that make sense. (pp. 141-142)

Hope from Voices of Resistance

On a more promising note, voices of resistance from girls at the margin sounded a note of hope, springing from the resilience and creativity of human agency. In this study, the voices of four participants, Stella, Celestina, Rachel, and Amanda, were much more complex and dynamic than that of Jessica, a "successful" conformist, revealing the multiple layers of their identities and the contending ideologies that constituted part of themselves (Bakhtin, 1981, Clarke & Holquist,

1984). Located in disparate, rather hostile, worlds, and exposed to contradictory cultural ideologies, they eagerly applied their critical thinking to make sense of a seemingly confusing and incoherent environment. It is true that these girls defined their situations differently and that their strategies for dealing with their situations diverged from one another. Yet, there were a few areas of common ground. All four girls had some degree of doubt about the legitimacy or fairness of many school practices. As a result, they did not totally commit themselves to the meritocratic ideology and justice principle as presented and practiced in their mathematics classroom and elsewhere at school. Rather, they actively searched for other ideas and even elaborated counter-ideologies that helped them preserve their self-worth, their individual voices, in school. To these girls, learning mathematics solely for its instrumental value was not enough: they "knew," intuitively, that learning mathematics could, and should, be more than that.

Of all the students, Amanda expressed this standpoint most clearly. She desired more from her mathematics class than receiving good grades, getting into college, and landing a good job in the future. Beyond that, she yearned for another “felt possibility” (Greene, 1995, p. 132) in her mathematics learning, intuiting the fact that learning involves a whole person, not only her left or right brain but also her entire existence in this world. She also knew that many more possible, not yet realized, meanings of learning were inherent in the process. Surprisingly, Amanda’s voice reflected the hidden, somehow forgotten, facet of academic endeavor—the holistic, and moral, dimension of learning that had been abandoned when intellectual inquiry surrendered its noble spirit to the fierce, pragmatic drive of economic power in capitalist society. Amanda insisted that learning mathematics itself could, and should, be something beyond what she experienced, and often suffered, in the classroom. To some extent, she resisted the sociocultural forces that attempted to make students mere “pawns” in their own learning and lives, viewing and learning mathematics for a single, narrowly defined purpose in a technology-driven postindustrial capitalist society (Jungwirth, 1993). Her desire, expressed in this study,

resonates with Maxine Greene's (1995) argument calling for attention to another important aspect of education that has been forgotten in the dominant educational discourse:

> Yes, one tendency in education today is to shape malleable young people to serve the needs of technology and the postindustrial society. However, there is another tendency that has to do with the growth of persons, with the education of persons to become different, to find their voices, and to play participatory and articulate parts in a community in the making. (p. 132)

Ideological Dynamic and Practicing Agency

Political awareness of our everyday lives was another interesting characteristic found in the voices of the girls who had difficulty conforming to the school ideology. They knew to some extent that their mathematics classroom was a place in which people, including themselves, practiced different values and moralities, e.g., the blind justice principle accepted by the teacher and the "smarties," and their own alternative ethic—the ethic of care. It was a place of political conflicts and negotiations: the teacher and each student exerted different ideals and values, threatening, persuading, and influencing one another. These girls did not view their mathematics class as a room to which they came simply to pick up a piece of knowledge so that they could "deposit" it for rewards, such as professional success, in the future. Rather, it was a place integral to their entire lives, where they still possessed an irrepressible desire to grow and reach to higher levels of understanding of the world and themselves. Also, it was a place where they wanted to feel self-worth, and be loved and respected by others. Recognizing the oppression and injustice existing in the classroom, these girls naturally developed their own political awareness and strategic voices, which called for alternative ethics, ideologies, and dreams.

Stella was a rather cautious actor in her two different worlds, intentionally changing her behavioral codes as she moved back and forth between her home and the school. In the classroom, she struggled to identify herself with the teacher and to conform to school ideology in order to construct a positive identity in the mathematics domain. At home and with her close friends, she returned to her personal self, hoping to remain secure within her own ethnic and

cultural community. Celestina adopted the feminine ideology to defend herself against the relentless pressure of meritocratic ideology. She actively used femininity to counterattack the seemingly unbeatable power of meritocratic ideology and the justice principle at school. Though she often found that she could not apply the ideology effectively in her mathematics class, there were many other places within the school where she could use it to protect herself from possible risks. Not surprisingly, she wanted to withdraw herself from the mathematics class, recognizing it as one of the most dangerous places for her to be, without any "safety net." Rachel, less passive, engaged in subtle political negotiation with the teacher. Grounded in her strong ethnic identity, she always preserved a certain distance between herself and PCMS teachers, including Mrs. Oliver. Rachel trivialized both the meritocratic and feminine ideologies, constructing her own world geared toward another goal: success as a professional athlete. Amanda elaborated an ethic of care more clearly than the other students. Her traumatic experience with her family helped her to reflect on the most important values in human relationships and, as a result, she criticized various school and classroom practices according to the ethic of care.

All of my student participants were caught in the flux of many competing voices and ideologies that constantly influenced their identities and motivation in mathematics, eventually constituting part of their voices, themselves. Yet, my participants were not mere scapegoats of the competing cultural ideologies in their classrooms, school, and society at large. They examined each ideology and subscribed to those that seemed to best express their desires and hopes in their world. Ultimately, they chose the one they believed would preserve their self-worth in the mutually shared world, including their mathematics classroom

Naturally, there were certain aspects of ideologies that the school represented to students as "right" and "legitimate" ideas. It is certainly true that "every educational system is a political means of maintaining or of modifying the appropriation of discourse, with the knowledge and powers it carries with it" (Foucault, 1997, p. 227). At PCMS, including Mrs. Oliver's classroom, meritocracy and the justice principle were the predominant ideologies in which the majority of

school practices were embedded and executed. Those ideologies tended to become more explicit in students' experience with mathematics for two reasons: the school's grouping practices in this subject and the teacher's strict approach to discipline in the classroom. As the school and teacher influenced students to embody the justice principle in their minds and bodies, the most conformist girls accepted it without difficulty or apparent reluctance. However, this seemed not to be the case among the girls with voices of resistance. Amanda, almost paradigmatically, resisted the tyranny of the justice principle in her classroom. Her intentional and conscious refusal to learn school mathematics was not surprising: it was the one of the few possible forms of resistance she could choose in that space, which she perceived as an unjust, inhumane, and unacceptable world. Her heavy silence and inactive participation were her way of resisting the tyranny of a principle that she could not accept.

One of the most disturbing findings of this study concerns the thought processes of Jessica, who had little critical consciousness and, as a result, conformed rigorously to the school's ideological program. Furthermore, she began to project herself as a judge, eagerly practicing the justice principle in her relationship with peers who came from dissimilar cultural backgrounds. She rarely doubted the fairness of this principle; in fact, she never seemed to question it at all. Her personal feelings of righteousness formed without a simultaneous development of her reflective thinking, and this resulted in a lack of understanding of other people with whom she lived her everyday life in the mutually shared school environment.

In contrast, girls from the margin did not believe in the justice principle, since it was obvious to them that it was not just at all. They understood its arbitrary characteristic because they were the very victims who regularly suffered under its unjust "justice." Their existential condition made them ponder the genuine meaning of justice and how they could bring "true" justice into their world. For this reason, girls from the margin constantly searched for a more effective ideology that would express their feelings, desires, and hopes for "true" justice.

Listening to the Voices of Resistance

In this study, the voices of the girls who came from the margin inspire us, as educators, to search for the hidden, rarely discussed dimensions of the world and the experiences of people living within it. Their voices require us to reevaluate our most basic conceptions of education and to re-examine several of its fundamental meanings and purposes. If we listen to the voices of resistance with the ears of the established order, they are at best useless, and at worst dangerous, noises. Perhaps this is what many teachers and "snobby smarties" hear in these voices. However, if we listen more carefully, their enigmatic message will unfold, awakening our critical consciousness and rejuvenating our desire to better understand and construct our world that is always in the making.

None of the girls I met at PCMS wished to fail in their academic endeavors, including mathematics. What the majority of them wanted was an opportunity to learn mathematics more meaningfully and with a sense of excitement. They wanted the system to listen to their voices and respond to their questions with honest respect. They knew intuitively that their questions and doubts were grounded in their authentic lived experiences at the school and in society; they did not need a "preaching" authority demanding that they throw away everything they genuinely felt and experienced, and act like others whom they never wanted to be. Instead, they needed their advocates. They wanted their teachers to practice collegiality, even solidarity, so that they could row together their mutually shared ark against the stream, the furious stream that treated them as soulless, innately inferior objects, and threatened their rights and freedoms in the realm of teaching and learning.

Girls in this study spoke in multiple voices. Some basically echoed the ideologies they had learned from their school, parents, peers, and other sources. Others, however, clearly reflected the hopes and critical consciousnesses that sprang from their existential conditions in the current educational system and society at large. These girls' own words and voices resisted various school practices and ideologies that repudiated their agency and potential for learning mathematics. They

elaborated their own standpoints, poignantly revealing the negative facets of a school system that overemphasized the instrumental value of learning mathematics and made it difficult, if not impossible, to feel the joy and excitement intrinsic to learning, which is such a natural part of human experience.

I want to emphasize that the voices of these young adolescent girls bear the hopes and possibilities, which help educators reexamine many un-critiqued practices in mathematics teaching. Their current struggles and expressed desires in learning school mathematics enable us to see the negative aspects of the system and open up new possibilities that mainstream adults, saturated, at least to some extent, with instrumental rationality, could not find by themselves. Clearly, these girls needed earnest, careful, and supportive listeners who attempted to understand the struggles and success in depth. Some of them needed more than a listener. They needed supporters who were willing to take a stand, become their advocates, and critically examine many un-critiqued practices in schools, including their own roles within the system. If this support system emerges, these girls will have much more to say about their modes of learning school mathematics. I am not sure where this endeavor will lead us, both educators and students. Perhaps it will lead to a "politicized mathematics class," in which mathematics learning and teaching are deeply intertwined with the teacher's and students' political awareness of choices and actions in their everyday classroom (Noddings, 1993). If so, we may develop an approach to school mathematics in which the motivation to learn is not restricted to instrumental value but rather encompasses a more vital, even beautiful, experience that will last throughout female students' journeys as lifetime learners.

Implications

Even though this study is based on deeply contextualized qualitative data derived from a limited number of young adolescent girls and their teacher within a particular school setting, it offers insights into the complexity of ethnicity and class issues, which have been minimally addressed in gender research in mathematics education.

First, the findings of this study indicate the profound impact of students' ethnicity and SES upon the teacher's perception, interaction, and expectations toward individual students. At times, this impact was rather direct. At other times, however, it was mediated by various factors and forces, such as particular types of cultural ideologies or social relationships between the teacher and parents. Yet, this impact was fairly consistent throughout the data. The conclusions of this stressed the urgent need to help teachers recognize and counteract the classism that has historically plagued our society and our schools. Because of the current economic disparity between Whites and ethnic minorities, classism is inevitably intertwined with racism. Some school practices and decision-making processes, e.g., mathematics streaming, often exacerbate the inequality in education by tending to prevent minority and working-class children from achieving a higher level of mathematical knowledge (Oakes, Gamoran, & Page, 1991). It appears to be an urgent task, particularly in teacher education, to help pre- and in-service teachers continue to pay attention to their schools' everyday practices and have the courage to raise their voices in resistance when their schools make decisions that may disadvantage girls, minority students, or students from working-class families. Helping our current and future teachers view themselves as advocates for those marginalized groups of students, such as girls, minority groups, and those from working-class backgrounds, should be an important part of teacher education.

Second, this study poses the need for a critical discussion of various types of school-related ideologies, e.g., the fair-school ideology, the justice principle, and the emphasis on the instrumental value of learning school mathematics. While White middle-class society tends to accept these ideologies as givens, many ethnic minorities and working-class people are not fully convinced of their validity. The educational system in the United States has functioned against the hopes and interests of minority and working-class people, and this negative impact constitutes their experiences with and knowledge of schools (Spring, 1997). As a result, ethnic minorities' and working-class people's subjective knowledge about schools has differed from that of more privileged groups in our society. It would seem to be critical for teachers to reexamine the

cultural and class affiliations of many apparently universal and objective ideas upon which their school or classroom practices are based. Culturally responsive teaching starts when teachers try to understand their students who come from different backgrounds and hold standpoints dissimilar to the teachers' own.

At the same time, it is worthwhile to recognize the different values and preferences in mathematics learning as expressed by the five girls participating in this study. Even though Jessica was thoroughly convinced of the instrumental value of mathematics and derived her motivation from it, most of the other participants needed more than the instrumental value to motivate them to learn. In order to reawaken interest and excitement in these girls, teachers must do more than repeat the rhetoric of the instrumental value of learning mathematics. In addition, certain cultural characteristics of their mathematics classes, including the authoritative, separate, competitive, and procedural method of teaching, must be revisited. In other words, educators can benefit most from the voices of the girls in this study when they accept the girls' critical point of view as a steppingstone to developing a more meaningful way of learning -- and teaching -- school mathematics.

Third, it is important to note that some minority students, particularly high achievers, experience intense anxiety and social pressure because they feel that their desires for school success on the one hand, and peer acceptance on the other, are mutually exclusive. This study illuminates the absurdity and ineffectiveness of fostering only "a few good students" out of many underachievers with whom the few good students share their ethnic and cultural identities. What is most needed is not an individual teacher's isolated effort to "save" the few good students, but rather a collective, consistent, and self-reflective effort by the community of educators directed toward the entire group of minority and working-class students. Without such realization and commitment, it will be hard to make a significant difference -- one that has a positive, long-term effect -- in the students' motivation and academic achievement in mathematics.

Fourth, this study suggests that the processes of class reproduction and marginalization of ethnic minorities were not automatic, but rather involved many unexpected and changeable factors and forces. Among these are individual agency and opportunities for exposure to different ideologies that help or disturb the reproduction process. For example, Stella wanted to identify herself with the teacher because this image constituted an important part of her positive identity in mathematics. Also, the academic success of Amanda, the working-class girl, in elementary school was based on the significant amount of cultural capital that she acquired from unexpected opportunities—having a knowledgeable elder sister and supportive teachers. I believe that this finding is extremely important because it gives us, as educators, a starting point from which we can, at least partially, break the vicious reproduction cycle. Students themselves constitute part of this hope with their agency factor, and teachers must participate in the process by creating various opportunities for their students.

Contributions of the Study

I believe that this study makes several contributions to our understanding of gender issues in mathematics education. In particular, this study illuminates the complexity and dynamics among girls' ethnicity, SES background, and social world, as well as their impact on the girls' identity, motivation, and actual achievement in mathematics.

First, the new theoretical framework in which this study is grounded makes a significant contribution to the existing perspectives on gender issues in mathematics education. The theoretical framework of this study consists of three different traditions in educational research, critical theory, feminist theory, and social constructivism. As a result, this study encompasses the issues of class, gender, and the sociocultural dimension of human individuality, and does not isolate one from the others. Based on the theoretical framework, this study shows that student motivation and achievement are complex phenomena, which involve numerous sociocultural factors and forces as well as individual agency and unexpected opportunity effect.

Another important contribution of the theoretical framework will be the reconceptualization of an individual's identity, including his or her motivation. Based on Bakhtin's sociocultural approaches to the mind, this study emphasizes the fact that student motivation itself has a sociocultural dimension in it. In particular, I focused on different social and cultural ideologies, which influenced and ultimately constituted aspects of the girls' identities and motivations in mathematics. I viewed these ideologies not only as some cultural ideologies existing outside of the girls' minds but also as important constituents of their identities and motivations.

The theoretical framework of this study also emphasizes the possibility of resistance through an individual's effort to make his/her own voice an expression of his/her agency. Based on the concepts of "voices of possibility/resistance" I was able to see the hopes residing in my participants' voices, which partly disturbed the reproduction cycle existing in their classroom, school, community environment, and society at large. I hope this framework continues to help me and other researchers identify more space in which conscious educators get involved and support their students in order to effectively disturb the reproduction process of gender inequity in mathematics education.

I believe that the research design of this study shows a new way of approaching gender issues in mathematics education. Gender research in mathematics education has predominantly been quantitative focusing on simple correlations among student achievement levels, different motivational constructs, or some sociocultural factors, such as student ethnicities and SES backgrounds. As a result, in-depth and more contextualized information about the actual reproduction processes of gender inequity have not been well documented. More important, this study closely examined the first-hand experiences of young adolescent girls with school mathematics, as well as the sociocultural context of their motivation. Many previous studies have confirmed that gender differences in both motivation and mathematics achievement emerge from young adolescence and that young adolescent girls experience various social pressures regarding their gender during this time. However, most previous studies investigating female students'

motivation were based on interviews with college students or adult women (Erchick, 1999, 2000; Issacson, 1999; Taylor, 1996).

In general, I believe this study is an important addition to gender research in mathematics education, which reveals the profound impact of sociocultural context upon girls' motivation for learning school mathematics. One of the most important findings of this study concern the dialogical nature embedded in the relationship between the sociocultural context and individual agency. I hope this study will lead researchers to a realization that student motivation and achievement are complex cultural phenomena, which could not be easily reducible either to individual personalities or some structural factors.

Future Research

I want to consider this study as a steppingstone, which can lead us to various research questions to be answered in the future. First, the findings of this study were deeply embedded in the sociocultural environment of a research setting. This study was conducted in a rural middle school, with a White female mathematics teacher and seven students who came from diverse ethnic and SES backgrounds. Interestingly, some findings of this study seems to suggest a picture of culturally responsive teaching for African American students, which was different from previous studies (Delpit, 1995). For example, a teacher's firm attitude and authoritative way of teaching can be interpreted differently depending on the sociocultural context and overall characteristics of his or her relationship with minority students. In order to acquire a more concrete understanding of sociocultural impact on girls' motivation, it will be essential to expand similar investigations in different educational settings, such as an African American teacher's math class with predominantly African American students in a metropolitan area.

Another important way to further the research findings of this study will be exploring the longitudinal data of adolescent girls throughout their schooling process. Longitudinal studies will help identify the various sociocultural factors and forces that affect girls' experiences with school mathematics in each stage of their academic, social, moral, and physical development. At the

same time, those studies will illuminate the changes and variations in girls' way of dealing with such sociocultural influences throughout the developmental course.

Lastly and more importantly, there is a need for conducting more praxis-based gender research in mathematics education. Praxis is an important factor that creates a different force and a whole new set of dialogical interactions in the reproduction cycle of gender inequity. Yet, there have been few studies examining such effects either with desirable outcomes or some unexpected results. Because of the scarcity of research focusing on the possible effect of praxis, educators and researchers tend to know little about the strategies that they can use to support girls' motivation for learning school mathematics. I believe that findings of this study should be furthered through a praxis-based research so that we can better understand the impact of human agency and other unexpected factors located in our journey toward gender equity in mathematics education.

Epilogue

Prior research on gender issues in mathematics education has made it clear that girls' failure and success in mathematics are complicated and multiple-layered sociocultural phenomena. Despite repeated calls for research that critically examines the impact of various sociocultural contexts, such as ethnicity and class, few studies actually addressed those issues. As a result, the complexity and dynamics embedded in the reproduction/resistance processes of gender inequity in mathematics were not well explained. It is my hope that the theoretical framework, methods of analysis, and findings of my study help us further our understanding of various inequity issues existing in mathematics education, and their relationships with gender inequity phenomena. Also, I hope my study will be an addition to the existing literature about women's different ways of learning, their unique worldviews and resistance to the world that seems not to make sense to them.

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APPENDICES

APPENDIX A

STUDENT ASSENT FORM

I agree to participate in Ms. Lim's study on middle school students' experiences with school mathematics. I understand that Ms. Lim wants to do this study in order to learn more about middle school students' experiences with school mathematics. Ms. Lim will observe my mathematics classes twice a week from February through June, 2001, and those classes will be audio-tape recorded. I also agree to volunteer for three consequent interviews with Ms. Lim. I will be interviewed individually and the interviews will be audio-tape recorded for later transcription. Interviews may be done within or outside of school such as at my house or at a public library depending on my guardian and my preference. I understand that Ms. Lim will access to my school records and learning materials such as my grades and written assignments for classes. I know that I can change my mind about participating in the interviews at any time.

_____ _____

Signature of the Researcher (Jae-Hoon Lim) Date

_____ _____

Signature of Participant (student) Date

Research title: "A Sociocultural context of young adolescent girls ' motivation for learning school mathematics"
Main Researcher: Jae-Hoon Lim, Elementary Education, 706-542-4244

You have rights as a research volunteer. If you have any questions about your rights please call or write: Ms. Julia Alexander, Human Subjects Office, University of Georgia, 604A Boyd Graduate Studies Research Center, Athens, Georgia 30602-6514; E-mail Address IRB@uga.edu.

APPENDIX B

PARENTAL CONSENT FORM

I agree to give my consent for my child _____ to participate in the research titled "Sociocultural context of young adolescent girls for learning school mathematics" which is being conducted by Jae-Hoon Lim. I understand that this participation is entirely voluntary; I or my child can withdraw consent at any time without penalty. I can choose to have the results of the participation, to the extent that it can be identified as my child's returned to me, removed from the research records or destroyed.

The purpose of this study is to allow the researcher to gather information about middle school girls' learning experiences with school mathematics. Ms. Lim wants to get this information on order to understand the overall experiences of female students in learning mathematics and to find a way to help them learn mathematics better in the future. This project has been explained my child. My child understands the explanation that has been provided, and what my child's participation will involve.

I agree to allow Ms. Lim to observe my child's school day, including his/her mathematics classes. Ms Lim will audio-tape record his/her mathematics classes twice a week. I also agree to volunteer my child for three consequent interviews throughout the period of Ms Lim's classroom observation. My child will be individually interviewed about his/her learning experiences with school mathematics. These interviews will be conducted within or outside of school such as in my house or at a public library as my child and I wish. All interviews will be audio-tape recorded for later transcription. I allow Ms. Lim to access to various school records of my child, such as his/her current and previous grades. Ms Lim can also access various writings and artifacts that my child has produced as part of his/her school assignment or classroom work. I understand that all observation and interview tapes will be erased after data analysis in the end of the study. Pseudonyms will be used for all data including tapes to guarantee confidentiality of my child.

_____ _____

Signature of the Researcher (Jae-Hoon Lim) Date

_____ _____

Signature of Participant (parent or guardian) Date

Research title: "A Sociocultural context of young adolescent girls ' motivation for learning school mathematics"
Main Researcher: Jae-Hoon Lim, Elementary Education, 706-542-4244

You have rights as a research volunteer. If you have any questions about your rights please call or write: Ms. Julia Alexander, Human Subjects Office, University of Georgia, 604A Boyd Graduate Studies Research Center, Athens, Georgia 30602-6514; E-mail Address IRB@uga.edu.

APPENDIX C

ADULT CONSENT FORM

(Teachers, Administrators, Parents, etc.)

I agree to speak with Ms. Lim regarding my perceptions of students' mathematics learning in school. I understand that this information is being collected in order to understand the difficulties and problems that young adolescents have in learning mathematics. Ms. Lim wants to collect this information so that she finds a way to help students learn better mathematics in the future. The purposes of the research have been explained to me.

I understand that interviews will be audio-recorded and transcribed. All responses will be kept confidential; I will be identified only by a pseudonym. I understand that all attempts will be made to remove identifying information.

I understand that 1 can withdraw my consent at any time. I can choose to have the results of the participation removed from the research records or destroyed.

_____ _____

Signature of the Researcher (Jae-Hoon Lim) Date

_____ _____

Signature of Participant Date

Research title: "A Sociocultural context of young adolescent girls ' motivation for learning school mathematics"
Main Researcher: Jae-Hoon Lim, Elementary Education, 706-542-4244

You have rights as a research volunteer. If you have any questions about your rights please call or write: Ms. Julia Alexander, Human Subjects Office, University of Georgia, 604A Boyd Graduate Studies Research Center, Athens, Georgia 30602-6514; E-mail Address IRB@uga.edu.

APPENDIX D

PROTOCOL FOR STUDENT INTERVIEW I

This is a loosely constructed interview protocol for the first interview with students. It is possible that I will not use all of these questions in an actual interview. Whether or not I use these interview questions will depend on the interview context with each participant. There are also some alternative questions that can be used in case the first question does not work well, or seems to be inappropriate in a certain context. In general, probing questions will be constructed based on each student's response, not the researcher's previously prepared question list. There are five areas that I intend to probe in each interview with the participants. This protocol is followed by a rough plan for the second and third interviews.

1. Questions to probe their general experiences with learning school mathematics

* Tell me about your mathematics classroom.

Alternative question: Give me a picture of your mathematics classroom (today).

* How do you feel when you are on your way to mathematics class?

* How do you feel in your mathematics class?

*Tell me what happened in today's mathematics class.

* Tell me about some outstanding events that happened in math class this week.

* Is there anything you can remember that people in your math class said this week? Why do you think you particularly remember that?

2. Questions to probe their concepts of mathematics and how to learn it

* What comes up in your mind when you think of mathematics?

* What do you think you can compare math to?

Alternative question: Can you think of any metaphor for mathematics? Tell me why you compare it with math.

* What do you think is the best way to learn mathematics?

* How do you think people learn mathematics?

* How do you think you learn mathematics?

* How do you study to be good at math?

* How do you study to get by math or get by math exams you have to pass?

* Who is the best student in your math class? Can you tell me what she or he does to be so good in math?

* Why do you think you have to learn math in school?

Alternative question: Where do you think you can use math in and out of school?

3. Questions to probe their motivation for learning school mathematics

*What do you like about math or learning math in school?

*What don't you like about math or learning math in school?

*Tell me about things that make you feel motivated in math class?

*Tell me about a time when you loved or really enjoyed mathematics. What kinds of things did you do then? Why do you think you enjoyed it so much?

* Tell me about specific events, situations or people that make you like or turn away from math.

4. Questions to probe their academic self-concepts in mathematics

* Do you think you are good at mathematics? Why or why not?

* Are you better at some parts of math than others?

* What does your teacher think of you as math student?

* What do your parents or family think of you as a math learner?

* What do your friends think of you as a math student?

5. Questions to probe influential sociocultural factors

* How do your friends feel about math?

*Alternative questions: What do your friends think of math?

How do your friends talk about math?

* Do your friends think it's important to be good at math?

* What do your parents or family feel or say about math?

* Tell me about times when your parents and family helped you learn math.

* Tell me about times when your parents and family were not that helpful for your math learning.

* What do your teachers, math teacher and other teachers, feel or say about math?

* Do your teachers think it's important for you to be good at math?

* Is there any other person who has changed your beliefs about math?

APPENDIX E

FOCUS QUESTIONS FOR SECOND AND THIRD STUDENT INTERVIEWS

The second and third interviews with students will be conducted based on the findings from my observation of their mathematics classrooms. I will ask questions regarding some incidents and events that occurred during their mathematics classes or other locations in school. The following are some possible areas that I will probe during the two interviews.

* The reasons for specific behavioral patterns observed in math class.
* Influences from media regarding their ability, usefulness of mathematical knowledge, stereotyped images of math, gender images related to math, and other academic fields.
* Students' attribution for success and failure in math.
* Students' family and its relationship with school, including the similarities and differences between the student' family culture and school culture.
* Peers' influences on math learning, including cross-gender relationships between boys and girls.

APPENDIX F

PROTOCOL FOR TEACHER INTERVIEW I

I conducted in-depth interviews with the mathematics teacher three times throughout the period of my classroom observation. The first was in February, the second and third were in April. These interviews were guided by a loosely-organized interview protocol, which helped me modify open-ended questions during the interview process. The purpose of these multiple interviews with the mathematics teacher was to acquire information about her general perceptions and understanding of mathematical knowledge, and her way of teaching mathematics. Some questions focused on her perceptions of and attitude toward students.

In the first interview, the researcher specifically focused on the teacher's general beliefs in and attitudes towards mathematics knowledge, her definition of and strategies for good mathematics teaching, and her overall perceptions and understanding of students' attitudes toward and motivation for mathematics learning. The subsequent interviews were based on my classroom observations and informal conversations with the teacher and students.

1. Life History of teacher

* Tell me about people or specific incidents that influenced you to be a mathematics teacher.

* Tell me about your professional journey from the beginning to now.

* Tell me about a special person or incident that was important in your professional life as a mathematics teacher.

* Have you met or been taught by a "good mathematics teacher"? when you were in school? If so, tell me about the teacher.

2. Questions probing teacher's general beliefs in mathematical knowledge.

* What comes up in your mind when you think of mathematics?

* What would you compare mathematics to?

(Alternative question) what kind of metaphor can you think of for mathematics?

* What do you think are the differences between mathematics and other subjects that students learn in school?

3. Questions probing teacher's attitude toward mathematics & mathematics teaching

* How do you feel when you are on the way to mathematics classroom?

* How do you feel when you are teaching in math class?

* Have you felt any differences when you teach math and when you teach some other subjects? (in case the teacher have taught other subjects except mathematics)

4. Questions probing teacher's perception about students' mathematics learning

* What is the most serious problem you confront in teaching mathematics to young adolescents? How do you deal with the difficulty?

* What do you think is the most serious problem for students in learning mathematics?

* What do you think is the best or most effective way to teach mathematics to young adolescents?

(Asking a concrete example for the above question)

* Tell me about a couple of students whom you taught and still particularly remember. What kinds of episodes did you have with them?

(Alternative question) Tell me about your success story with a student or a group of students.

APPENDIX G

WORKING DEFINITION OF TERMS

Cultural/social capital – Forms of symbolic capital, "which are neither Marxian nor formal economic, entails the capacity to exercise control over one's own future and that of others" (Postone, LiPuma, & Calhoun, p. 4). Cultural capital refers to cultural patterns, "the way of talking and acting, moving, dressing, socializing, tastes, likes and dislikes, competencies, and forms of knowledge that distinguish one group from another," (deMarrais & LeCompte, 1998, p. 207) which ultimately increase an individual's or a particular group's chances of accessing economic capital. More direct forms of cultural capital are professional licenses and qualifications, but there are more subtle forms, such as linguistic codes. Social capital refers to various social relationships and group memberships which ultimately help generate economic gains for an individual or a particular group of people.

Habitus – "A set of ideas about how the world operates, what is to be valued, what one's place in society is, and which actions are correct or proper" (deMarrais & LeCompte, 1998, p. 208). It is "a system of general generative schemes that are both durable (inscribed in the social construction of self) and transposable (inscribed in the social function on an unconscious plane, and take place within a structure's fields of operation). The habitus is at once intersubjective and the site of the constitution of the person-in-action; it is a system of dispositions that is both objective and subjective" (Postone, LiPuma, & Calhoun, p. 4).

Ethic of hard work – A person's or people's idea or belief that hard work itself is a natural and essential human virtue, and that it would and should be rewarded in the long run.

Fair-school ideology - An assumption or belief that school practices are generally fair, well-intended, and ultimately serve to benefit all students at school.

Meritocratic ideology – An idea that each individual should be rewarded based on their merits, their ability, performance, or productivity levels. On one hand, meritocratic ideology negates the importance of ascriptive characteristics of individuals, such as family membership. On the other hand, it legitimizes the unequal distribution of various economic and cultural resources and power prevalent in capitalist society.

Justice Principle – An idea that justice is objective and universal and can be represented by a hierarchical set of rules and regulations, and that each person has the primary responsibility for his or her choices and actions no matter what the circumstances are. Rewards and punishments are viewed as natural consequences of the individual's choices and actions.

Ethic of care – Often used as a contrasting concept to the justice principle in this study, it refers to the idea that everybody has the responsibility to take care of others, particularly those who are most in need. Fostering a positive interpersonal relationship and reaching for a contextual understanding are more important than practicing blind impartiality.

APPENDIX H

COMPARISON OF FIVE PARTICIPANTS

Participant	Jessica	Stella	Celestina	Rachel	Amanda
Ethnicity	Caucasian	African American	Hispanic	African American	Caucasian
SES	Middle class	Working class	Middle class	Working class	Working class
Streaming	Advanced	Advanced	Regular	Regular	Advanced
Cultural Conflict between home & school	No	Yes	No	No	Yes
Coherent identity at home & school	Yes	No	No	Yes	No
Knowing school system	Yes	No	Yes	No	Yes
Achievement level	High	High	Low	High	Low
Confidence in ability	High	Mixed	Low	High	High
Like math	Yes	Mixed	No	Yes	No
Relationship w teacher	Positive	Mixed	Mixed	Positive	Negative
Anxiety level	Low or moderate	Very high	High	Low	High
Desire for getting in to algebra class	Very strong	Mixed	Not wanting	No consideration	Mixed
Characteristics of peer group	High-achieving girls from similar SES background	African American girl who achieve high or low	Caucasian girls from middle class, failing in their academic work	African American girls & boys, mostly athletes	Caucasian girls troubled, & high-achieving African American girls
Experiences w school	Positive	Mixed	Negative	Mixed	Negative
Ideologies accepted	Fair-school ideology; Justice principle; meritocratic ideology	Part of meritocratic ideology	Feminine ideology; ethic of care	Sports success ideology; ethic of care	Ethic of care; Feminine ideology;
Ideologies resisted	Negative effect of feminine ideology on academic achievement	Feminine ideology; fair-school ideology	Justice principle; meritocratic ideology	Feminine ideology; fair-school ideology	Fair-school ideology; justice principle
Teacher expectation	High	Middle	Low	Low	Low