Learning From Teaching:
Exploring the Relationship between 'Reform' Curriculum and Equity.

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Jo Boaler, Stanford University

Abstract.

Concerns have been raised about the potential of reform-oriented curriculum for promoting equity. This paper considers this important issue and argues that investigations into equitable teaching must pay attention to the *particular* practices of teaching and learning that are enacted in classrooms. Data are presented from two studies in which middle and high school teachers using reform-oriented mathematics curriculum achieved a reduction in linguistic, ethnic, and class inequalities in their schools. The teaching and learning practices that were employed are shown to be central to the attainment of equity, suggesting that relational analysis of equity, that go beyond the curriculum, to include the teacher and their teaching, are critical.

Introduction.

The relationship between different teaching methods and students' understanding of mathematics is one that has fascinated teachers and researchers for decades (Benezet, 1935). When the mathematics reform movements of the 1980's were developed in different countries across the world, they were based upon the idea that open-ended problems that encourage students to choose and combine different methods, and discuss different solution methods with their peers, would provide productive learning experiences. There was considerable support for such ideas and the last 20 years have witnessed the development of a plethora of curriculum materials that centralize open ended and contextualized mathematics problems. However, such materials and their associated teaching methods, have not been well received by all parties (Battista, 1999; Becker & Jacob, 2000). Some of the objections to reform-oriented approaches have come from mathematicians and others who gained considerable understandings through more traditional routes (see, for example, Wu, 1999; Klein, 2001). Other objections have come from those who prefer to maintain the traditions of the past and who view changes to school presentations of mathematics as a challenge to the social order (Rosen, 2000; Stephen Ball, 1993). Recently objections have come from a more unexpected source – some of those within the education academy who are particularly concerned with equity have expressed concern that reform-oriented approaches to mathematics may not enhance achievement for *all*, as was originally hoped and claimed (Lubienski, 2000).

Lubienski (2000) monitored her own teaching of a reform-oriented curriculum to a class of students and noted that the working class students were less confident and successful than the middle-class students. Some of the students attributed their lack of success to the open-ended nature of the work, which prompted Lubienski to question the prevailing notion that 'reform' curriculum materials are advantageous for all children. Delpit (1988) has also raised questions about 'progressive' reform movements, particularly their potential to distribute achievement more equitably, on the basis that schools reproduce a 'culture of power' (p.485), and that 'if you are not already a participant in the culture of power, being told explicitly the rules of that culture makes acquiring power easier' (p486). Delpit provides a number of examples of teaching approaches employing principles of 'reform' that, she argues, exacerbated inequalities, as cultural and linguistic minority students expected and wanted teaching to be more direct, with explicit communication of the rules to which society attends. Delpit talked particularly about progressive approaches to reading, arguing that skills-oriented approaches may be more equitable because they tell students about concepts and skills rather than providing experiences through which students may learn them. Both Delpit and Lubienski raise concerns about the access that some students receive to new curriculum approaches, raising extremely important questions for the future. In giving examples of reform oriented approaches that did not reduce inequality they also point to an urgent need for a greater understanding of the ways in which mathematics reform approaches, developed to enhance conceptual understanding, may do so more equitably.

The idea that some students may be disadvantaged by some of the reform-oriented curriculum and teaching approaches that are used in schools is extremely important to consider and may reflect a certain naiveté in our assumptions that open teaching methods would be accessible to all. But whilst the realization that some students may be less prepared to engage in the different roles that are required by open curriculum is very important, analyses that go from this idea to the claim that traditional curriculum are more suitable may be extremely misleading. This is partly because they reduce the complexity of teaching and learning to a question of curriculum, leaving the teaching of the curriculum relatively unexamined. Some reform approaches have been found to promote equity and high achievement (Silver, Smith & Nelson, 1995; Boaler, 1997a) and it seems important to understand the conditions that support such achievements and examine the ways in which they differ from others (Greeno & MMAP, 1998). This could advance our understanding of teacher practices that are productive in open environments and the teacher learning that may support them. The field of mathematics education does not currently have a nuanced or well-differentiated knowledge base of equitable teaching practices. The first wave of research into the impact of reform approaches has tended, necessarily, to report upon the relationships between broad teaching approaches, such as group work or whole class discussions, and student understanding (Hiebert and Weane, 1993; Boaler, 1998). In this paper I open these and other teaching practices for closer examination and contend that the differences between equitable and inequitable teaching approaches lie *within* the different methods commonly discussed, and that greater insights into equity will require an understanding of the ways teachers work to enact different approaches.

The idea that 'traditional' curriculum may be more appropriate for some students is not only problematic because it focuses only upon the curriculum. The claim that open ended materials and methods are less suitable for working class or ethnic minority students is potentially dangerous because it feeds into an educational system in which many already subscribe to the view that working class students cannot cope with more demanding work (Boaler, 1997a; Gutiérrez, 1996). In such a context analysts need to be particularly careful and responsible in their reporting, making sure that all possible sources of equality and inequality are carefully examined. Haberman has referred to the procedural teaching that is frequently offered in urban schools as a 'pedagogy of poverty' (Haberman, 1991; Ladson-Billings, 1997) and Anyon has noted the prevalence of more closed and procedural approaches in working class schools (Anyon, 1980, 1981). Observations that reform curriculum do not always eradicate inequalities that are *not* accompanied by investigations into the ways they may do so could continue these deficit patterns of opportunity.

The third problem with claims that traditional approaches may be better for some students is that such analyses locate the problem within the students. It seems important that educators understand the needs of different groups of students, not so that we may develop negative ideas about students' mathematical potential (Varenne & Mcdermott, 1999), but so that we may develop awareness of the ways in which schools can better meet their needs. This will require a shift in focus away from what *students cannot* do – cope well with open ended work for example – onto what *schools can* do, to make the educational experience more equitable. The aim of this paper is to begin such an investigation, drawing from different studies that give insights into the ways that equitable achievement may be achieved.

Theories of cultural reproduction.

Investigations into sources of inequality have led researchers to propose that certain cultural elements mediate the relationship between people's lives and the economic structures of society (Mehan, Hobbard & Villanueva, 1994), through a process in which children learn cultural knowledge from their families – ways of dressing, speaking, interacting and so on. It is further proposed that children from working class homes acquire a different form of cultural capital (Bourdieu, 1986) than children in middle or upper class homes and that schools recognize the cultural capital of middle class learners. Thus, middle class children are more likely to be defined as effective in school merely because of their 'congruency with the formal context of schooling' (Zevenbergen, 1996, p105).

Theories of reproduction (Bowles & Gintis, 1976; Bourdieu & Passeron, 1977) that draw from both sociology and anthropology, do not deal with overt intentions, or claim that teachers deliberately support students of their own gender, race or class above others. They deal instead with more subtle demonstrations of power that 'relate to linguistic forms, communicative strategies and presentation of self; that is ways of talking, ways of writing, ways of dressing, and ways of interacting' (Delpit, 1988, p486). Such theories are persuasive as they provide explanations for the fact that schools not only reflect, but re-enforce the class disparities of society, despite the best intentions of educators. These theories relate to mathematics reforms as researchers have argued that the norms of reform-oriented classrooms are more consonant with the norms of white, middle class homes. Delpit draws from Heath's data (1983) to argue that white, middle class students are used to interpreting indirect statements from parents, whereas black and working class students expect facts and rules to be communicated more directly. Thus she questions the accessibility of progressive approaches to reading as, she argues, they provide experiences through which students may learn important facts, norms and traditions, rather than direct opportunities for students to gain access to them. There have been significant objections to theories of cultural reproduction with claims that they are overly deterministic, emphasizing social and structural constraints at the expense of individual actions (Varenne & McDermott, 1998; Mehan, 1992). For students do not just assume, or uncritically accept the norms of the home or school, they play an important part in forming, accepting and, for some, resisting such norms (Apple & Christian-Smith, 1991). But sociologists and anthropologists seem to agree around at least one issue: learning to be successful in school involves understanding and following the rules of the school game, what Pope (1999) has defined as 'doing school', and middle class learners seem to be advantaged in this respect.

Learning practices.

One of the important understandings that may be gained from theories of cultural reproduction is the idea that there are certain practices that students need to learn in school in order to be successful, and that these are related to, but go beyond understanding of subject content. This fits with an emerging body of research that is showing the importance of students understanding their role in reform-oriented classrooms. Corbett and Wilson (1995) argue that those working to promote educational reforms have generally overlooked the fact that students not only need to develop new ways of working in reform oriented classrooms, but an understanding of, and commitment towards, the changes in their roles.

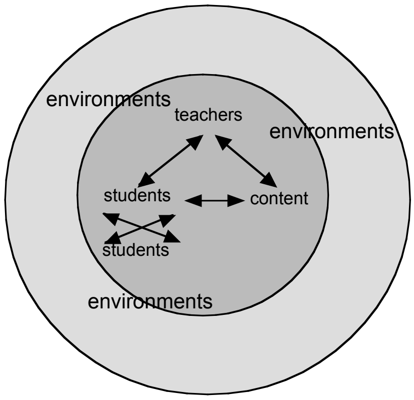
They argue that 'students must change during reform, not just as a consequence of it' (1995, p12). This is a simple but important point that has been given surprisingly little attention. Thus researchers have written extensively about the ways students may benefit from reforms paying relatively little attention to the implications of such reforms for student roles. David Cohen and Deborah Ball (2000) have termed the different practices that students need to employ and understand in school – *learning practices* – and one important practice that Corbett and Wilson draw attention to is the act of explaining work. In traditional mathematics classrooms students are required to produce correct answers, but in reform-oriented classrooms they often need to go beyond correct answers and explain their methods, justifying the approaches they have used. Lubienski (2000) reported that middle class students in her class were more likely to justify their answers in line with the expectations of the reform curriculum she used, than working class students. She used this finding as an illustration of the possible inappropriateness of open-ended curriculum, but it could equally be given as an example of a teaching opportunity. Students do not only need to learn mathematics in classrooms, they need to learn particular schooling and learning practices. An important task for researchers in the future may be to consider the ways in which the different learning practices that support successful participation in 'reform' mathematics classrooms, may be learned.

Yackel and Cobb (1996) draw attention to the norms of mathematics classrooms, distinguishing between norms that they describe as social and those that are socio-mathematical. Their depiction and naming of the repeated practices of classrooms in which teachers and students engage, and that develop gradually over time, has been extremely generative. This is partly because classroom norms, such as 'what counts as an acceptable mathematical explanation and justification' (1996, p461), pay attention to a level of detail in the enactment of teaching that has been lacking within many analyses (Lampert, 1985). The notion of socio-mathematical norms offers a lens through which to examine and describe the colors and contours of mathematics classrooms, giving name to some of the important choices to which teachers and students attend in the activity of mathematics teaching and learning. The notion of learning practices operates at a similar level of detail, drawing attention to the specific actions and practices in which students need to engage in different classrooms. Knowing when and how to take notes as a teacher talks is an example of a learning practice in which students may need to engage, but that is rarely given specific attention or taught. There are many different learning practices that may give students access to the classroom norms that are in place in their classrooms and, concurrently to mathematical understanding and success. These range from general practices - such as asking questions or taking notes - to specific practices such as knowing to represent difficult mathematics problems as a diagram. Polya (1971) and others have considered what successful mathematics problem solvers *do*, producing lists of strategies that they use to solve problems. Learning practices could include such strategies, as well as the other actions in which students need to engage to be successful in their mathematics classrooms. 'Reform' classrooms require a different set of learning practices from those in more traditional classrooms and if these are currently inequitably distributed, as Lubienski and Delpit highlight, then it seems important to consider ways in which they may be learned by all students.

The field of mathematics education does not currently have an extensive or well developed knowledge base of the particular ways in which teachers may mediate curriculum approaches to make them equitable, including, for example, the learning practices to which they may need to pay explicit attention. The development of such a knowledge base seems to have been severely hampered by the pervasive public focus on curriculum approach. Teachers, researchers, mathematicians and policy makers have all argued about the *curriculum* that should be used in classrooms. But whilst opponents and proponents of different curriculum have argued about the importance of open-ended work or structured questions, they have rarely considered the ways in which teachers may manage such approaches, the teacher knowledge they may require (Ball & Bass, 2000) or the changed student roles that may need to be learned in order for different approaches to be successful (Corbett & Wilson, 1995). The "math wars" as they have been termed in the United States, have comprised bitter battles fought in schools, districts and the pages of the press as opponents and proponents of reform-oriented teaching argue their cases. Such battles are unfortunate for many reasons, not least the fact that the broad focus on curriculum necessitated by such arguments has served to reduce the learning experience to an interaction between students and curriculum. This has taken attention away from the teaching practices that mediate student success and that may require considerable understanding and support.

Cohen, Raudenbush, and Ball (2000) have suggested that such an understanding will be encouraged by a focus on the interactions that constitute learning and the detailed practices that take place at the intersection of teachers, students and content, in environments. They have proposed that mathematics teaching and learning be represented by an instructional triangle (see figure 1), the vertices of which are teachers, students and content.

Figure 1: 'Instruction as interaction of teachers, students and content in environments'. (Cohen, Raudenbush & Ball, 2000)



Cohen, Raudenbush and Ball (2000) propose that learning opportunities take place at the intersection of these different variables and that few learning occasions can be understood without consideration of the contribution made by the teacher, the students, the discipline of mathematics and the ways that they interact within environments. They further propose that environments, traditionally regarded as outside influences, 'become active inside instruction' (2000, p14). Their focus on practice is consistent with the perspective of situated theory (Lave & Wenger 1991; Lave, 1996; Greeno & MMAP, 1998) and it has profound implications for research, curriculum, and professional development. One implication of focusing upon the practices of mathematics classrooms is that insights may be provided into the interactional nature of teaching and learning. Thus, in any one moment of teaching and learning, a researcher may seek to understand the relationships between and among the curriculum question, the teacher mediation of the question, the student responses and the pervading classroom norms (Boaler, 2000a,b). A focus on practice also enables a level of *detail* that Lampert (1985), and Chazan & Ball (1999) have argued is critical for understanding 'teacher moves'. Lampert has proposed that: 'efforts to build generalized theories of instruction, curriculum, or classroom management based on careful empirical research have much to contribute to the improvement of teaching, but they do not sufficiently describe the work of teaching' (1985, p179). This focus upon general methods of instruction, at the expense of particular teacher moves, is pervasive within and outside the education community. Broad teaching approaches and curriculum questions are extremely important to consider, but Ball, Cohen, Chazan, Lampert and others have argued lucidly that understanding the difference between effective and ineffective teaching will require a focus upon the *practices* of teaching and learning.

In an effort to describe and examine the interactions that constitute teaching and learning, and the particular teacher moves that promote equity, I will spend time in this paper analyzing two particular examples of equitable teaching and learning practices, one that I studied in England and one that took place in the United States. Both of these approaches were 'reform oriented' and they contributed towards a reduction of linguistic, ethnic, and class inequalities. The fact that these approaches contributed to the promotion of equity is important, casting doubt upon claims that reform-oriented approaches are inequitable. But in the final section of this paper I will consider a more important question – what methods did the teachers use to promote equity in their mediation of the reform curriculum? I will consider only a small proportion of the teachers' practices, but these will show that any reduction of the learning experience to an interaction between students and curriculum is essentially flawed, as teachers and their teaching of different curriculum are central to the promotion of equity.

Evidence of Equitable Teaching.

In previous editions of JRME I summarized the results of a three-year investigation into the experiences and achievements of approximately 300 students as they attended secondary schools with vastly different mathematics teaching approaches in England. Both schools were situated in low-income areas and the majority of students at both schools were white and working class. One of the schools used an open-ended approach for mathematics ('Phoenix Park') the other a procedural, skill-based approach ('Amber Hill'). In previous reports I mentioned, but did not expand upon the fact that the teachers using an open-ended approach also achieved more equitable outcomes. Unusually in that study I investigated the relationship between mathematics achievement and social class for the 300 students, from when they began their different approaches at age 13, until they reached the end of compulsory schooling at age 16 (Boaler, 1997b). When the 110 students in the year cohort at Phoenix Park started at the school there were already significant class disparities in their achievement. The correlation between social class and mathematics attainment at that time was 0.43[1]. I had not monitored the students' experiences prior to their time at Phoenix Park, but knew that the middle schools they attended employed ability grouping and traditional curriculum. In England, social class often correlates significantly with achievement, as well as placement in ability groups – a process that is purported to contribute towards social inequalities (Stephen Ball, 1981, Tomlinson, 1987, Abraham, 1995). When the students left Phoenix Park school three years later, having worked in mixed ability groups on an open, project-based mathematics curriculum, the partial correlation between achievement and social class, after controlling for initial attainment – was 0.15. At Amber Hill school where the teachers used a procedural approach to mathematics there was a beginning correlation between the students' attainment at age 13 and their social class of 0.19. It was not possible to know why the beginning correlation was so different at the two schools, but the Amber Hill students had worked for the previous 2 years in mixed ability groups, whereas the Phoenix Park students had worked in 'tracked' groups. After three years of working on their procedural mathematics curriculum in ability groups the partial correlation between the Amber Hill students' social class and achievement, after controlling for initial attainment, was 0.30 (n=196). At the beginning of the study the cohorts of students at the two schools were matched by gender, race and social class and there were no significant differences in their mathematics attainment at that time. Three years later the students at the project based school

(Phoenix Park) scored significantly higher grades on a range of assessments, including the national examination, (χ^2 (1 , N = 290) = 12.5, $p < 0.001$). This was despite the comparability of the attainment of the students in the two schools at age 13 and the extra time the students spent 'on task' at Amber Hill – the traditional school (Boaler, 1997a). At Amber Hill the boys also gained significantly higher grades than the girls, but there were no gender disparities in achievement at Phoenix Park. Thus the school that used an open ended approach not only achieved significant results with the students – who gained higher examination results than the national average, despite being in one of the poorest areas of the country – but they reduced inequalities in gender and social class. These results, particularly the increase in class polarization at Amber Hill, stand in direct contrast to Lubienski's proposition that 'the algorithmic mode of instruction might provide a relatively level playing field' (2000, p478) and in the second part of this paper I will consider the particular teaching practices and beliefs that appeared to impact the attainment of equity at the two schools.

The QUASAR project (Silver, Smith & Nelson, 1995; Brown, Stein & Forman, 1996; Lane & Silver, 1999) started from the assumption that mathematical proficiency could be attained by all students and that attainment would be raised in poor and minority communities if teachers placed a greater emphasis on problem solving, communication and conceptual understanding. Teachers in six urban middle schools in the US, serving socially and culturally diverse populations of students, spent 5 years developing and implementing a more open and discursive mathematics curriculum. Students learned about facts and algorithms, but they also learned when, how, and why to apply procedures and they used the procedures they learned to solve high-level problems. There were a number of similarities between the QUASAR and Phoenix Park approaches, including mixed ability classes, a focus on problem solving, high expectations for all students, attention to a broad array of mathematical topics and the encouragement of discussion and justification. The QUASAR students' achievement was measured over time revealing dramatic results. The students made significant gains in their achievement, they performed at significantly higher levels than comparable student groups on a range of different assessments and the gains were distributed equally among the different racial, ethnic and linguistic groups of students.

The results of these and other studies (Knapp, Shields & Turnbull, 1995) cast considerable doubt on claims that open-ended approaches are less suitable for working class and minority children – but they also raise an important question. Why did the 'reform' oriented approaches of the Phoenix Park and QUASAR teachers appear to promote equity when other 'reform' curriculum have not reduced inequalities (Lubienski, 2000)? The answer to this question may be important to our field and I will spend some time now addressing the particular practices of teaching and learning that the Phoenix Park and QUASAR teachers employed and that appeared to impact the attainment of equity.

A Focus on Teaching and Learning Practices.

At Phoenix Park school the curriculum was designed by the teachers. They did not use any books or work-cards, instead they brought together a collection of different open-ended projects, that generally lasted for two to three weeks of mathematics lessons (for more information on Phoenix Park's approach, see Boaler, 1997a). The teachers designed the curriculum as part of a working group of teachers who were developing open approaches in six different schools. They met as part of the Association of Teachers of Mathematics (ATM), the British equivalent to NCTM. When I conducted my research study the school had been using an open-ended approach for two years.

When the Phoenix Park students arrived at the school many of them immediately took to the open-ended mathematics approach to which they were introduced, despite the 8 years they had spent working on more closed and traditional

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mathematics questions before they attended Phoenix Park. But some of the students, particularly boys, found the openness of the work they were given extremely disconcerting. They, like some of the students Lubienski reported (2000), said that they were uncomfortable with the lack of structure or suggested direction in the problems, and that they would prefer a more traditional approach. These students, along with the majority of students at Phoenix Park, came from homes of severe poverty, living on a housing estate (similar to a US project) that was infamous for drug-related crimes and "joy-riding", and where police would not venture at night. When I interviewed the students at the beginning of the study they described their motivations clearly:

> S: When I go into a maths lesson I usually sit down and I think - who am I going to throw a rubber (erasure) at today? (Shaun, PP, year 9, RT)

> JB: Can you think of a maths lesson that you've enjoyed?
> M: Messing about, that's what I enjoy doing.
> JB: What would make maths better?
> M: Working from books – you don't mess about if you've got a book there, you know what to do. (Megan, PP, year 9, RT)

Although some of the students *blamed* their misbehavior on the openness of the work, the teachers did not give the students books or structure. This may have been the easiest option, but the Phoenix Park teachers believed that the open-ended approach they used was valuable for *all* students and that it was their job to make the work equitably accessible. They therefore developed a range of practices that served to increase the students' access to the problems they met and the methods they were expected to use. I will give evidence of three of their equitable practices in this paper, both in order to highlight these particular practices and in order to illustrate the importance of the detailed teacher "moves" that could become a greater part of the lexicography of mathematics education (Lampert, 1985).

(i) Introducing activities through discussion. One practice that was central to the Phoenix Park teachers' approach was one of introducing the activities to students themselves, through discussion. This enabled the teachers to decide upon the degree of support or structure students needed. In the three years that students attended Phoenix Park they were never left to interpret text-based problems alone. The teachers always spent time with individuals, groups or the whole class introducing ideas and making sure students all knew how to start their explorations. Phoenix Park teachers would frequently ask students to gather around the board when new problems were being introduced, and when homework was being set, in order to have some discussion of the problems that were being posed. Similar practices were evident in the QUASAR classrooms. Smith (2000) reports her observations of an urban middle school teacher who used the same curriculum as Lubienski. She reports that the teacher would ask students to read problems aloud in class, then hold a discussion about the context of the problem and any vocabulary used, in case either was unfamiliar. Then she would ask students to discuss what they thought the task was asking them to do. After such discussions the teacher would ask groups to work on the task and check that different individuals understood what they should do. Such practices were employed by Phoenix Park and QUASAR teachers in order to make tasks equally accessible, but they contrast with many classrooms in which students are left to interpret the aim of problems from their reading of reform texts, which are often extremely wordy and linguistically demanding. The way in which work is introduced to students and the access students are given to the mathematical ideas that they are intended to explore seems extremely important.

(ii) Teaching students to explain and justify. A second important feature of the Phoenix Park teachers' practice was that they paid attention to the ways in which students communicated their understanding, as well as the students' understanding of the need for that aspect of their work. As part of their commitment to encourage students to explain and justify their thinking, the teachers at Phoenix Park offered frequent encouragement to individual students to explain their reasoning and communicate in more detail, as the students were not used to doing so when they arrived at the school. In one of the lessons I observed, a student gave in a problem on which he had been working, that showed some of his methods, and a correct answer. The teacher studied it for a while, then said:

> 'Brilliant work John but you can't just write it down, there must be some sense to why you've done it, some logic, why did you do it that way?, explain it.' (Rosie Thomas, year 10)

Rosie's 'there must be some sense to why you've done it' typifies the sort of encouragement the students were given at Phoenix Park. The teachers strove to expand the way in which the students thought about mathematics, extending the students' value systems beyond the desire to attain correct answers. There was considerable evidence that they were successful in that regard:

> I: It's an easier way to learn, because you're actually finding things out for yourself, not looking for things in the textbook.
> JB: Was that the same in your last school do you think?
> I: No, like if we got an answer, they would say, "you got it right". Here you have to explain how you got it.
> JB: What do you think about that?
> I: I think it helps you. (Ian, Year 10)

In one of the lessons I observed, the teacher asked all the students to gather round the board, then she posed the following question: 'If someone new came into class and they asked you what makes a good piece of work? What does Ms Thomas like? What would you say?' The first student offered 'lots of writing', others offered suggestions such as 'have an aim', 'draw a plan' and 'write about patterns'. Each time the teacher came back with further questions – such as 'is the amount of writing important?' or 'what does that mean?', 'why is a plan important?' 'what does a good plan look like?' 'why do we record patterns?' The students struggled over many of their explanations but they sat around the board engrossed in this discussion for some time. The students were clearly appreciative of the opportunity to learn about valued ways of working. As they talked the teacher kept a record of the students' suggestions on the board. After approximately 40 minutes of discussion the teacher told the students that their task was to design a poster describing the different features of 'good work'. She also gave them a page that the department had prepared that was called 'hints for investigations'. It was divided into three columns, headed 'what to say', 'how to say it' and 'making sense of it', these showed different suggestions for students, such as 'can you make the problem more general? Make the original problem more difficult' and 'now explain how or why your algebraic rules work'. The students studied the page and incorporated many of the suggestions into their posters. This lesson explicitly focused upon the mathematical *learning practices* (Cohen & Ball, 2000) of explanation and justification that the students needed to employ in the pursuit of their mathematical investigations. Many of the practices were those that are valued in other reform-oriented classrooms, but teachers do not always give them such explicit attention. They assume that students will understand the need for their use and the changed practices they need to employ.

In Lubienski's recent report (2000) she observed that working class students were reluctant to explain their work, and concluded from that experience that a more structured approach may be more equitable. When the Phoenix Park teachers found that some students were not communicating their thinking or interpreting numerical answers, they devoted more time to this aspect of their teaching, regarding the students' reluctance as a gap in their understanding of what was required in the work.

(iii) Making 'real world' contexts accessible. One of the reservations Lubienski and others have expressed about reform-oriented teaching concerns the use of 'real world' contexts. Many of the reform-oriented curriculum that are used in different countries are replete with contexts that are intended to bring some realism into the mathematics classroom. I share Lubienski's concerns about the potential these hold for increasing the gap between low and high SES students, as well as boys and girls (Boaler, 1994, Murphy, 1990; Murphy & Gipps, 1996) and students of different cultural groups (Silver, Smith & Nelson, 1995; Ball, 1995, Zevenbergen, 2000). One of the problems presented by real world contexts is that they often require familiarity with the situation being described and such familiarity cannot always be assumed. In Deborah Ball's teaching of mathematics to a linguistically and culturally diverse class of elementary students she found that some contexts were 'unevenly familiar or interesting' which caused some distraction and confusion in ways that 'diminished the sense of collective purpose' in her class (1995, p672). Ball therefore led the students into explorations of theoretical, abstract and at times esoteric mathematical concepts that fascinated the children, causing her to conclude that contexts are far from necessary for the encouragement of high level thinking amongst young children. One significant problem that is provided by many of the contexts used in mathematics examples occurs when students are required to engage partly as though a context in a task were real whilst simultaneously ignoring factors pertinent to the 'real life version' of the task. As Adda (1989) suggests, we may offer students questions involving the price of sweets but students must remember that 'it would be dangerous to answer them by referring to the price of sweets bought this morning' (Adda 1989 p 150). But mathematics books – particularly the commercially produced reform-oriented curriculum to which Lubienski refers – are full of examples of pseudo-situations that students are meant to partially consider. Knowing how much consideration to give to the real world factors presented in questions has now become a form of school knowledge that students need and that appears to be differentially distributed (Boaler, 1993; 1994; Zevenbergen, 2000; Cooper and Dunne, 1998). The QUASAR teachers addressed this issue by engaging students in conversations about the meaning of the different contexts they encountered in questions. In one published example, the teacher introduced a question about the most economical way to buy bus tickets – as a weekly pass, or daily tickets. The textbook authors intended students to calculate the most cost effective tickets, but the students, understandably, considered the variables in the question – such as how often they would use a weekly ticket and the different family members that could use it. Lubienski (2000) offers similar examples of students in her class who considered the contexts provided and the variables that would be presented in the 'real world', considering whether people would want 'seconds' in what was intended to be a straightforward calculation of pizza divisions. When the QUASAR teacher realized that students were situating their reasoning in the context of their lives and that there was more than one 'correct' answer to the problem she changed her expectations and provided students with opportunities to explain their reasoning. Silver, Smith & Nelson (1995) conclude from this situation that: 'increasing the relevance of school mathematics to the lives of children involves more than merely providing "real world" contexts for mathematics problems; real world solutions for these problems must also be considered.' (1995, p41). The QUASAR teachers redefined their expectations and roles to make use of the students' experiences and their integration of mathematical and 'real world' variables. Silver, Smith & Nelson (1995) point out that contexts present an important opportunity for teachers to make the educational experience more equitable for children, and that teachers should deliberately provide

opportunities for students to 'negotiate transitions among frames of reference' (1995, p24). In doing so they acknowledge the additional school knowledge that contextualized questions require and the role that teachers may play in distributing that knowledge more equitably. This knowledge of the ways in which contexts should be interpreted and used is likely to be of value in many institutionalized settings (such as those involving high-stakes assessments) as it lies at the core of 'doing school' (Pope, 1999).

At Phoenix Park the teachers rarely gave the students contextualized mathematics questions from published curriculum, but they attempted to make the different mathematical explorations relevant to the students by relating them to their lives. For example, when they introduced work on statistics, they asked the students to collect data that was of interest to them from newspapers and magazines. When they worked on patterns and tesselations they asked students to bring patterns into school that they liked. In another situation one of the teachers I observed suggested that a girl who was interested in babies, investigated the admissions policy of the school nursery that was attached to the school. The Phoenix Park teachers encouraged students to relate mathematics to issues and topics in their lives. They, like the QUASAR teachers, did not expect students to interpret contextualized textbook questions exactly as the textbook authors intended, assuming some degree of reality *but not too much* (Wiliam, 1997).

The Phoenix Park and QUASAR teachers encouraged students to interpret the mathematical and 'real world' variables presented in different problems – and their relationship with each other. In doing so they were able to promote equity and teach students to view mathematics as a flexible means with which to interpret reality. There are important reasons for teachers to move mathematics instruction beyond the abstract that make explorations of ways they may do so equitably extremely worthwhile. The recognition that girls and boys, as well as students of different social, cultural, or linguistic groups encounter contexts differently is relatively recent and researchers from across the world are considering the implications of this finding (Zevenbergen, 2000; Cooper & Dunne, 1998). The recommendations that are emerging from this work center upon ways that teachers may use contexts more equitably, allowing students to consider the constraints that real situations provide, and encouraging attention to the 'code switching' that contexts require and that may be a more general and important feature of 'doing school' (Pope, 1999).

The three practices I have highlighted were intrinsic to the Phoenix Park teachers' success in engaging students in reform oriented mathematical investigations, even though the students were not used to such work when they arrived at the school. After months of careful support from the Phoenix Park teachers, the students who had struggled and been extremely reluctant to accept an open approach to work started to become more engaged with their work and more comfortable with the freedom they were given. The change in some of the disaffected boys became most obvious when, in the second year of the school, they were taught by a student teacher who tried to teach mathematics in a more traditional way. In the following extract from my observation notes the boys start to complain, because of the *closed* nature of the work that was given to them. This was very different from the approach to which they had, by then, become accustomed:

> The teacher starts the lesson by asking the class to copy what he is writing off the board. He is writing about different forms of data, qualitative and quantitative. The students are very quiet and they start to copy off the board. The teacher then stops writing for a while and tells the students about the different types of data. He then asks them to continue copying off the board. After a few minutes of silent copying Gary shouts out 'Sir when are we going to do some work?', Leigh follows this up with 'Yeah are we going to do any work today sir?' Barry then adds 'This is

> boring, it's just copying'. The teacher ignores this and carries on writing and talking about data. The boys go back to copying. The teacher looks across at Lorraine, who is looking puzzled, and asks her if she 'is OK' she says 'No not really, what does all this stuff mean?'. This seems to annoy the teacher, or make him uncomfortable, he turns back to the board and continues writing. Gary persists with his questioning, this time asking 'Sir, why are we doing all this?', the teacher replies: 'We are just rounding off the work you have done.'
>
> After about 20 minutes of board work the teacher asks the students to go through all of their examples of data collection that they have done over recent weeks and write down whether they are qualitative or quantitative. Peter asks 'Sir what's the point of this?, aren't we going to do any work today?' the teacher responds with 'you need to know what these words mean.' Peter replies 'But we know what they mean, you've just written it on the board so we know'. (Phoenix Park, student teacher, year 10)

This series of interactions was particularly interesting to observe because it was the group of boys who had been most resistant to open-ended work who objected to the closed nature of the work the student teacher gave them. The boys repeatedly asked 'whether they were going to do any work today', indicating that they did not regard copying off the board as work, probably because it did not present them with a problem to solve. When the student teacher told them to classify data as quantitative or qualitative so that they would learn what the words meant, Peter questioned the point of this because they had already been told what they meant. Yet the mathematics teaching offered in this example is fairly characteristic of more traditional high school mathematics pedagogy in which the teacher explains what something means to students, they copy it down from the board and then they practice some examples of their own. The degree of resistance the students provided seems important to consider. In a different class the regular teacher was absent one day, when he returned one of the previously resistant boys complained about the substitute teacher they had been given, saying: 'It was terrible – we had this teacher who acted like he knew all the answers and we just had to find them'.

My description of the different aspects of Phoenix Park and QUASAR teachers' practices that helped students gain access to the 'reform' approaches – helping students understand the questions that were posed, teaching students to appreciate the need for written communication and justification, and discussing ways in which to interpret contextualized questions – were only a small part of the teachers' repertoire of teaching beliefs and practices, but they provide some illustration of the complex support that teachers may need to provide students when reform-oriented approaches are used. Ball and Bass (2000 a,b) have provided a careful analysis of the mathematical understandings that teachers need when they engage students in collaborative explorations. This has shown that teaching approaches based upon student investigations, exploration and discussion confer additional demands upon mathematics teachers that we are only now beginning to understand. Confrey (1990) observed a teacher who employed constructivist principles and recorded the particular methods the teachers used to promote student thinking. Some of these methods, including asking students to re-state problems in their own words, were used by the Phoenix Park teachers to great effect. Henningsen and Stein (1997) also provide an extremely valuable analysis of the particular aspects of the QUASAR teachers' practices that supported understanding. These included: using tasks that built on students' prior understanding, giving appropriate amounts of time, and modeling high level performance. Such detailed investigations and descriptions of the ways teachers enact reform approaches are unusual but they may be essential to advancing our understanding of the demands of reform-oriented teaching and the development of more appropriate learning opportunities for teachers.

Discussion and Conclusion.

Sociologists propose that open approaches to learning do not only give access to a depth of subject understanding, they encourage a personal and intellectual freedom that should be the right of all people in society (Willis, 1977; Ball, 1993). Further, they suggest that opportunities for higher level thinking are inequitably distributed in schools, which serves to maintain the structural class inequalities that exist in many societies – a process Willis describes as: 'working class students being prepared for working class jobs' (1977). Anyon has provided some insight into this relationship. She found that schools in poor and working class areas 'discouraged personal assertiveness and intellectual inquisitiveness in students and assigned work that most often involved substantial amounts of rote activity' (Anyon, 1981, p203). The mathematics teaching in the working class schools she studied was procedural, rule-bound and involved the learning of set methods by rote. In more middle class, professional and elite schools the mathematics teaching involved choice, analytical reasoning, discussion of different methods and an emphasis upon mathematical processes (Anyon, 1980). Amber Hill school conformed to this trend as the mathematics teachers offered a structured, procedural approach and they explained to me in interviews that they needed to do so because the students were from poor backgrounds and they would not have been able to cope with open-ended work. This was not a malicious belief – the teachers simply believed that students did not receive the support they needed at home to cope with work that was linguistically and conceptually demanding and so they provided them with more structure to help them. The Phoenix Park teachers did not hold these beliefs – they thought that all students could benefit from open work and that the students' home lives should not be a barrier to their pursuit of mathematical explorations.

Lubienski (2000) has suggested that algorithmic approaches to mathematics teaching may reduce class inequalities because they convey clear and direct messages. This is an interesting assertion but it leaves open the question of the content and nature of the messages conveyed by 'algorithmic' approaches. One of the findings of my study in England was that the procedural approach employed at Amber Hill school did not reduce inequities. Indeed a comparison of the students' initial attainment at age 13 and their eventual attainment at age 16 revealed that 80% of the students attaining above their projected potential at Amber Hill were middle class whereas 80% of the students achieving below their projected potential were working class. At Phoenix Park the 'over' and 'under' achievers were equally distributed among working class and middle class students (Boaler, 1997a,b). But the fact that the Phoenix Park approach was more equitable than the Amber Hill approach should not be taken as evidence that open approaches are necessarily more equitable, only that the Phoenix Park teachers and students worked together in ways that reduced inequalities. Similarly, this paper should not be taken as an indication that all 'traditional' approaches are inequitable or wrong, some students go beyond procedural approaches to make their own connections and develop considerable understandings (Boaler & Greeno, 2000). But whilst this is possible for some students, particularly the more mathematically oriented, it was not the case for the majority of the Amber Hill students. It would be reasonable to argue that procedural approaches can be different to the ones employed by the Amber Hill teachers. But such an argument supports my main point - sources of equitable teaching lie *within* the particular practices in which teachers engage in classrooms.

Anyon and others suggest that teachers tend to offer working class students more structure – presenting mathematics as a closed domain with clear rules to follow – and I have argued that such practices are misguided and inequitable. Other researchers have noted a relationship between the level of mathematics that is taught and the degree of structure provided. Thus, some teachers believe that students who experience more difficulty should be given more structure (Orton & Frobisher, 1996; Confrey, 1990). This idea is easy to understand, particularly for those of us who have been in teaching situations when a student has expressed frustration at trying to understand a concept and the provision of a structured procedure would have encouraged immediate ‘success’. But my observations of teaching and learning in high and low attainment groups, and interviews with students in these groups (Boaler, Wiliam & Brown, 2000) have demonstrated the importance of questioning the relationship between mathematical level and structure. Additionally, the Phoenix Park teachers demonstrated that students of all levels and backgrounds could be enabled to develop a conceptual understanding of the mathematics with which they were engaged. They did not succumb to the temptation of spoon-feeding those students who sought such help and the rewards of their hard work were demonstrated by the students’ achievements. This is not to suggest that teachers should never make decisions to provide students with additional structure, only that such decisions should not correlate with mathematical level or social class. As long as we hold conceptual understanding as a goal for students, then it is imperative that such a goal is held for *all* students. Awareness that students of low SES or achievement encounter difficulties interpreting open work, must be accompanied by a drive to understand the students’ experiences better and provide action to make the teaching of open ended approaches more equitable (Ball, 1995).

My limited description of the work of the Phoenix Park and QUASAR teachers is intended to serve as an illustration, both of the *particular* teaching practices that need to be considered in mathematics classrooms, and the effectiveness of teachers who work to engage all students, through their commitment to equity and the goals of open ended work. Gutiérrez (1996, 1999, 2000 a,b) has provided more detailed and careful analyses of teachers who achieved equitable outcomes using ‘reform’ curriculum in low-income, culturally and linguistic diverse communities. She concluded from this work that our greatest hope for providing equitable teaching environments is to focus upon ‘teacher capacity building’ (Gutiérrez, 2000b) investing our time and resources in the teachers who enact ‘reform’ curriculum. The Phoenix Park mathematics department was relatively unusual. In England, schools rather than districts, choose new teachers and the Phoenix Park department had carefully selected new teachers who wanted to teach through open ended projects and who shared a commitment to equity. In addition, the mathematics activities at the school had been chosen and designed by the teachers. This meant that the teachers shared a commitment to and knowledge of the activities they used. This is different to the scenario that often plays out in American schools whereby the district chooses the curriculum and the teachers. 'Reform oriented' curriculum are often used by teachers who have received no training to teach them and who hold no commitment towards them. But whilst the Phoenix Park department may be unusual, the results they achieved are an important illustration of what can be done. The role of the teacher in the provision of high level, equitable teaching environments has been minimized in debates around curriculum (Becker & Jacob, 2000) and minimized in some analyses (Lubienski, 2000), but it seems that the teachers’ mediation of different curriculum approaches is central to the attainment of equity. Further, it seems that advancing awareness of the particular learning practices that are required by reform-oriented approaches and that are currently inequitably understood, may be an important stage in promoting equity. The different teachers whose work I have reviewed in this paper all spent time sharing understanding of the learning practices that students needed in their work on open mathematics problems - with the students. The equitable advances that were made demonstrate two important points. First, that understanding the ways in which open approaches promote equity will involve consideration of the *detailed* practices of teaching and learning that occur in classrooms (Chazan & Ball, 1999). Second, that such work may contribute towards helping mathematics teachers replace the ‘pedagogies of poverty’ (Haberman, 1991, p290) that often predominate in low income and minority communities, with pedagogies of power.

References.

Abraham, J. (1995). *Divide and School: Gender and Class dynamics in comprehensive education*. London: Falmer Press.

Adda, J. (1989). The Mathematics Classroom as a MicroSociety. In C. Keitel, P. Damerow, A. Bishop, & P. Gerdes (Eds.), *Mathematics, Education and Society* . Paris: United Nations Educational Scientific.

Anyon, J. (1980). Social class and the hidden curriculum of work. *Journal of Education, 162,* (1), 67-92.

Anyon, J. (1981). Schools as Agencies of Social Legitimation. *International Journal of Political Education, 4* (3), 195-218.

Apple, M., & Christian-Smith, L. (1991). The Politics of the Textbook. In M. Apple & L. Christian-Smith (Eds.), *The Politics of the Textbook* (pp. 1-21). London: Routledge.

Ball, S. J. (1981). *Beachside comprehensive*. Cambridge: Cambridge University Press.

Ball, S. J. (1993). Education, Majorism and the 'curriculum of the dead'. *Curriculum Studies, 1* (2), 195-214.

Ball, D. L. (1995). Transforming Pedagogy - Classrooms as Mathematical Communities: A Response to Lensmire and Pryor. *Harvard Educational Review, 65*, 670-677.

Ball, D. L., & Bass, H. (2000a). Bridging Practices: Intertwining Content and Pedagogy in Teaching and Learning to Teach. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching and Learning* (pp. 83-104). Westport, CT: Ablex Publishing.

Ball, D. L., & Bass, H. (2000b). Making Believe: The Collective Construction of Public Mathematical Knowledge in the Elementary Classroom. In D. Phillips (Ed.), *Yearbook of the National Society for the Study of Education: Constructivism in Education* . Chicago: Chicago University Press.

Battista, M. (1999). The Mathematical Miseducation of America's Youth. *Phi Delta Kappan, Feb 1999*, 425-433.

Becker, J., & Jacob, B. (2000). California School Mathematics Politics: The Anti-Reform of 1997-1999. *Phi Delta Kappan, March*, 529-537.

Benezet, L. P. (1935). The Teaching of Arithmetic I; The Story of an Experiment. *Journal of the National Education Association, November 1935*, 241-244.

Boaler, J. (1993). The role of contexts in the mathematics classroom: do they make mathematics more "real"? *For the Learning of Mathematics, 13*(2), 12-17.

Boaler, J. (1994). When do girls prefer football to fashion? An analysis of female underachievement in relation to "realistic" mathematics contexts. *British Educational Research Journal, 20*(5), 551-564.

Boaler, J., & Greeno, J. (2000). Identity, Agency and Knowing in Mathematics Worlds. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching and Learning* (pp. 171-200). Westport:CT: Ablex Publishing.

Boaler, J., Wiliam, D., & Brown, M. (2000). Students' experiences of ability grouping- disaffection, polarisation and the construction of failure. *British Educational Research Journal, 27*.

Bourdieu, P., & Passeron, J.-C. (1977). *Reproduction in Education, Society and Culture*. Beverley Hills: California: Sage.

Bourdieu, P. (1986). The Forms of Capital. In J. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education* (pp. 241-258). New York: Greenwood Press.

Bowles, S., & Gintis, H. (1976). *Schooling in Capitalist America: Educational Reform and the Contradictions of Economic Life*. New York: Basic Books.

Brown, C. A., Stein, M. K., & Forman, E. A. (1996). Assisting teachers and students to reform their mathematics classroom. *Educational Studies in Mathematics, 31*(1-2), 63-93.

Chazan, D., & Ball, D. L. (1999). Beyond being told not to tell. *For the Learning of Mathematics, 9*, 2-10.

Cohen, D. & Ball, D.L. (2000, April) *Instructional innovation: Reconsidering the story.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Cohen, D., Raudenbush, S., & Ball, D. L. (2000). *Instruction, resources, and research* : Center for Teaching Policy, Seattle, WA: University of Washington.

Confrey, J. (1990). What Constructivism Implies for Teaching. In R. B. Davis, C. A. Maher, & N. Noddings (Eds.), mathematics *Constructivist Views on the Teaching and Learning of Mathematics* . Reston, VA: NCTM.

Cooper, B., & Dunne, M. (1998). Anyone for tennis? Social class differences in children's responses to national curriculum mathematics testing. *The Sociological Review, Jan*, 115-148.

Corbett, D., & Wilson, B. (1995). Make a difference with, not for, students: A plea to researchers and reformers. *Educational Researcher, 24*(5), 12-17.

Delpit, L. (1988). The Silenced Dialogue: Power and Pedagogy in Educating Other People's Children. *Harvard Educational Review, 58*(3), 280-298.

Greeno, J. G., & MMAP. (1998). The Situativity of Knowing, Learning and Research. *American Psychologist, 53*(1), 5-26.

Gutiérrez , R. (1996). Practices, beliefs and cultures of high school mathematics departments: understanding their influence on student advancement. *Journal of Curriculum Studies, 28*(5), 495-529.

Gutiérrez , R. (1999). Advancing Urban Latina/o Youth in Mathematics: Lessons from an effective High School Mathematics Department. *The Urban Review, 31*(3).

Gutiérrez , R. (2000a). *Advancing Latina/o Urban Youth in Mathematics: The Power of Teacher Community.* Paper presented at the NCTM, Chicago.

Gutiérrez, R. (2000b, September). *Towards a More Humane Version of Equity in Mathematics Education.* Paper presented at the Equity in Mathematics Education meeting, Northwestern University.

Haberman, M. (1991). The pedagogy of poverty versus good teaching. *Phi Delta Kappan, 73*, 290-294.

Heath, S. B. (1983). *Ways with words*. Cambridge: Cambridge University Press.

Henningsen, M., & Stein, M. K. (1997). Mathematical Tasks and Student Cognition: Classroom-Based Factors That Support and Inhibit High-Level Mathematical Thinking and Reasoning. *Journal for Research in Mathematics Education, 28*(5), 524-549.

Hiebert, J., & Wearne, D. (1993). Interactional Tasks, Classroom Discourse, and Students' Learning in Second-Grade Arithmetic. *American Educational Research Journal, 30*(2), 393-425.

Klein, D. (2001). A Brief History of American K-12 Mathematics Education in the 20th Century. Paper posted on *Mathematically Correct* Web-site, Aug 1, 2001.

Knapp, M., Shields, P. M., & Turnbull, B. J. (1995). Academic Challenge in High Povery Classrooms. *Phi Delta Kappan, 76*, 770-776.

Kohn, A. (1998). Only For My Kid: How Privileged Parents Undermine School Reform. *Phi Delta Kappan, April*, 569-577.

Ladson-Billings, G. (1997). It Doesn't Add Up: African American Students' Mathematics Achievement. *Journal for Research in Mathematics Education, 28*(6), 697-708.

Lampert, M. (1985). How Do Teachers Manage to Teach? Perspectives on Problems in Practice. *Harvard Educational Review, 55*(2), 178-194.

Lane, S., & Silver, E. A. (1999). Fairness and Equity in Measuring Student Learning Using A Mathematics Performance Assessment: Results from the QUASAR Project. In A. L. Nettles & M. Nettles (Eds.), *Measuing Up: Challenges minorities face in educational assessment* (pp. 97-120). Boston: Kluwer.

Lave, J. (1996). Teaching, as learning, in Practice. *Mind, Culture and Activity, 3*(3), 149-164.

Lave, J., & Wenger, E. (1991). *Situated Learning: legitimate peripheral participation*. New York: Cambridge University Press.

Lubienski, S. (2000). Problem Solving as a Means Towards Mathematics for All: An Exploratory Look through the Class Lens. *Journal for Research in Mathematics Education, 31*(4), 454-482.

Mehan, H. (1992). Understanding Inequality in Schools: The Contribution of Interpretive Studies. *The Sociology of Education, 65*(1), 1-20.

Mehan, H., Hubbard, L., & Villanueva, I. (1994). Forming Academic Identities: Accommodation without Assimilation among Involuntary Minorities. *Anthropology and Education Quarterly, 25*(2), 91-117.

Murphy, P. (1990). Assessment and Gender. *Cambridge Journal of Education, 21*(2), 203-214.

Murphy, P., Gipps, C., & UNESCO (Eds.). (1996). *Equity in the Classroom: Towards Effective Pedagogy for Girls and Boys*. London: Falmer.

Orton, A., & Frobisher, L. (1996). *Insights into Learning Mathematics*. London: Cassell.

Polya, G. (1971). *How to Solve it: a new aspect of mathematical method*. Princeton, NJ: Princeton University Press.

Pope, D. (1999). *Doing School: "Successful" Students' Experiences of the High School Curriculum.* PhD Thesis. Stanford University, Stanford.

Rosen, L. (2000). *Calculating Concerns. The Politics of Representation in California's "Math Wars".* , University of California San Diego.

Silver, E., Smith, M. S., & Nelson, B. S. (1995). The QUASAR Project: Equity concerns meet mathematics reforms in the middle school. In W. G. Secada, E. Fennema, & L. B. Adajian (Eds.), *New Directions in Equity in Mathematics Education* (pp. 9-56). New York: Cambridge University Press.

Simon, D., & Burns, E. (1997). *The Corner: A Year in the Life of an Inner-City Neighborhood*. New York: Broadway Books.

Smith, Margaret (2000). Personal Communication.

The Office of Population Censuses & Surveys (1980). *Classification of Occupations 1980* London: HMSO

Tomlinson, S. (1987). Curriculum option choices in multi-ethnic schools. In B. Troyna (Ed.), *Racial Inequality in Education* (pp. 92-108). London: Tavistock.

Varenne, H., & McDermott, R. (1999). *Successful Failure: The School America Builds*. Boulder, Colorado: Westview Press.

Wiliam, D. (1997). Relevance as MacGuffin in mathematics education. *Chreods, 12,* 8-19.

Willis, P. (1977). *Learning to Labor*. New York: Columbia University Press.

Yackel, E., & Cobb, P. (1996). Sociomathematical Norms, Argumentation, and Autonomy in Mathematics. *Journal for Research in Mathematics Education, 27*(4), 458-477.

Zevenbergen. (1996). Constructivism as a Liberal Bourgeois Discourse. *Educational Studies in Mathematics, 31*, 95-113.

Zevenbergen, R. (2000). "Cracking the Code" of Mathematics Classrooms: School Success As A function of Linguistic, Social and Cultural Background. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching and Learning.* (pp. 201-224). Westport, CT: Ablex Publishing.

Footnote

[1] Social class was determined using the Office of Population Censuses & Surveys (1980) categorization of parental occupations. This converts occupations into categories of social class. I recorded parental occupations by asking the students to name and describe the last jobs their parents held.