

VOICES FROM THE
OTHER SIDE OF THE ROOM:

A STUDY ON CHANGING TEACHING STRATEGIES TO
INCLUDE GIRLS IN MATH, SCIENCE AND TECHNOLOGY

By
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A Thesis
Submitted to the Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
for the Degree of

Doctor of Philosophy

Department of Educational Administration and Foundations
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CHERYL KRISTJANSON

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DOCTOR OF PHILOSOPHY

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ABSTRACT

The gender inclusive pilot project was developed to address the disparity in enrolment, achievement and attitudes between young women and men in a secondary school. The project utilized a participatory research design where five teachers and a coordinator focused on changing the teaching practices and classroom environment within their math, science and computer science classes.

The pilot project applied a participatory research approach to observe and assess whether current research findings about young women's experiences in schools did exist in the lives of their students. The reality was that they did. Through a process of assessing students' classroom environment and learning styles and of conducting interviews with the students, the project found that three connections were critical for learning for females and other marginalized groups. These were:

1. A connection between the student and the teacher.
2. A connection between the subject material and the student.
3. A connection between the subject material and their real world.

The teachers in the project focused on adapting their teaching strategies and classroom environment in order to establish these connections with and for their students. The results were an improvement in young women's enrolment, achievement and attitudes towards math, science and technology.

The study also discusses the teachers' attempt to spread their success with their students beyond their classrooms to a larger audience of teachers within the school. A discussion of the connections amongst teacher beliefs, actions and school culture is presented through a series of letters to students, staff, policy makers and researchers.

“if we had a keen vision and feeling of all human life, it would be like hearing the grass grow and the squirrel’s heartbeat, and we should die of that roar which lies on the other side of silence”

(George Eliot)

This thesis is dedicated to the students and teachers at my school, who have enriched this work by adding their voices to the writing.

A special thanks to my thesis chair, Benjy Levin, and my committee Jon Young, Keith Louise Fulton and Janice Dodd for their valuable suggestions and patience.

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PROLOGUE

THEN:

The gender inclusive pilot project was initiated in the fall of 1991 at an inner-city school in Winnipeg. The school, built along gothic lines of brick and stone is permeated with a sense of tradition, complete with a courtyard surrounded on all sides by high windows and balconies. In a sense, the school's physical structure symbolizes the traditions and values that have been closely guarded within its walls for almost a century. One might expect, viewing it from the outside, that it would be filled with predominantly white upper class students, much like a scene from an English prep school. Inside however, the scene is quite different. The halls are filled with students representing 62 different nations and varying social and economic status.

As you walk inside, only the staff seem to mirror what you might have expected upon entering the building. They are predominantly a blend of middle-class euro-Canadian backgrounds. Their average age is approximately 48 years. Many of the staff have taught for over 20 years and a few only at this particular school. Two out of three administrators are male and the leadership style has been described as authoritarian. For 64% of the staff, teaching has been their only profession. In some ways, the curriculum has not changed significantly for many years and one need only walk into the dusty book rooms to find evidence of tattered textbooks.

As you stroll down the math, science and technology wings of the school and peer into the classrooms you see desks neatly arranged in

rows and the imprints of where they were once bolted to the floor in that position still visible. In almost every case, the instructor is positioned at the front of the room seemingly with an overhead projector attached to one hip lecturing on a particular topic for the day. Students sit diligently copying the given information into their notebooks. When questions are asked, responses are called out mainly from the boys' side of the room.

NOW:

Returning to the school four years later, your initial impressions remain. The brick and stone building is still as imposing as you remember but as you enter the front doors the first changes are noticeable. The administration has changed. The principal is now a woman as is the first vice-principal and the second vice-principal is a male visible minority. All of the administrators can be seen strolling the halls chatting to students by name and on occasion cajoling them along to class.

As you approach those same math, science and technology classrooms the first thing you notice is that some have been remodelled and updated. In many cases, desks have been replaced with new tables and chairs that are arranged in groups. Computers appear in individual classrooms and in one instance an entire classroom has been changed into an integrated Math/English lab. Each classroom you look into seems to be doing something different. The teachers move amongst their students sometimes appearing to be in two places at the same time. One classroom has students busily working on computers. In another, groups consisting of boys and girls are huddled over white boards solving a problem. In

the next classroom, students are engaged in a reflective writing assignment. Another class listens attentively to a woman scientist teach part of their curriculum and in the last they appear to be listening to a lecture. In all the classes, one thing is constant; the voices no longer come from only the boys' side of the room.

INTRODUCTION

The gender inclusive pilot project sponsored by the Walter and Duncan Gordon Charitable Foundation was originally developed in the fall of 1991 to address the disparity of participation, self-esteem and achievement levels between young men and women in math, science and computer science classes in a Manitoba High school. This project is also part of my ongoing research on gender issues in education. I first started this journey seven years ago when I became involved in the topic of systemic discrimination against women in leadership positions at our Canadian universities. I had the privilege of coming to know the woman in my study, Mary Jane Mossman, and the trials of understanding the depth of discrimination against women in our educational system. Although I had many unanswered questions at the end of my master's thesis I was convinced that the only way to change society's attitudes towards women was through education. Enacting laws or implementing gender equity programs may increase opportunities but falls well short of changing people's beliefs.

Soon after completion of my master's thesis I became involved with a coalition of women who were also concerned with women's experiences in education. This coalition was called the Coalition of Organizations for the Education and Training of Women. I worked with three other women on a sub-committee of this group to obtain funding from the office of the Secretary of State to conduct a research study that would attempt to construct an alternative vision of schools, one we called Gender Inclusive. We defined gender inclusive education to mean the including of women's experiences, values, contributions and ideas on an equal

level to those of men within our school system. As well, we believed that for women to have an integral place in our schools and classrooms these classrooms would need to be restructured or "transformed". Through a process of conducting a review of literature and interviews, we identified some common themes that became our initial principles of gender inclusive education. These principles included such things as a need for education to have an over riding focus, a connectedness to the teaching and learning process, cooperative learning styles and inclusionary methods of instruction. After some initial attempts to secure support for these ideas, I became convinced of two additional things: that we needed to pilot some of these ideas that we described and that instituting a project that attempts to change peoples' beliefs and actions fundamentally would be a very difficult and at times personally and professionally arduous task. As the coalition was unable to secure financial support for our ideas, I made the decision to pursue the idea of piloting the gender inclusive project on my own.

This dissertation is the result of an attempt to pilot some of those ideas. It is an examination of some of the beliefs, actions and changes that took place within ourselves as teachers, our classrooms and our school as we attempted to challenge the status quo and implement gender inclusive teaching strategies. The first section, chapters 1-3 of the dissertation will present the reasons for our attempts to change our classrooms. Chapter 1 outlines some of my own beliefs about the connection between patriarchy, power and schools. Chapters 2 and 3 will discuss the assessment that was done of our classrooms and what we discovered about our girls' experiences in school.

The middle section, chapters 4-9 explains the actions we took to

address the inequities we discovered and the outcomes that resulted from those actions. Chapters 4-7 are grouped under a common theme of "connectedness". Chapter 8 will deal with student assessment. Chapter 9 will discuss the student and project teacher outcomes and chapter 10 outlines the unexpected outcomes. The epilogue is written as a series of personal letters where I speak to four different audiences: the students, the five teachers I worked with, the Minister of Education and Training and finally other researchers. I have chosen to address different audiences, including you the reader, to emphasize the issue of voice. We often speak in different voices according to the roles we play and the relationship we have established with our audience. In a sense, voice is used as a mask. Because I held many roles in the school; researcher, coordinator, teacher and colleague, I struggled with the issue of which voice to use. I was not comfortable using the researcher's third person voice of distance and objectivity as it attempts to mask our bias and interpretations. Instead, I chose to write in the voice that was most appropriate for the audience. I have also included extensive unedited quotes from the teachers and students throughout the dissertation so you can hear their voices as well as mine. The importance of voice will be a theme that runs throughout the dissertation, and I will elaborate on this issue later.

You will notice, that the citations I have used sometimes include both names and sometimes only last names. The use of both names is an attempt to acknowledge that the author(s) are women. In some cases, the use of both names also indicates the importance of the work to me. Where I make passing or repeated reference to a piece of literature or where the first names were not available, citations will be by last name

only. I had the opportunity to present the gender inclusive project at an international conference on women in science and technology (GASAT) in 1992. The similarities in the struggles and types of work that are being done throughout the world influenced me to cite research from these countries in my dissertation. Although some of the works cited may be dated I feel they are still relevant or important works. I use Carol Gilligan's (1982) work on the moral reasoning of young women as an example.

RESEARCH METHOD:

Feminist researchers, as well as other fields such as critical theory, humanism and phenomenology often challenge the more traditional methods of quantitative research. Maguire (1987) in her book *Doing Participatory Research: a feminist approach* discusses the need for alternative forms of research. She states that "the pervasiveness and often unquestioned acceptance of positivist-informed research cuts us off from serious consideration of alternative assumptions and subsequent approaches to the production of social knowledge. Positivist social science research is called dominant because for most social scientist and educators it is the only legitimate way to create knowledge" (Maguire, 1987, p.9). Maguire (1987) goes on to say that "the power of a paradigm is that it shapes, in nearly unconscious and thus unquestioned ways, perceptions and practices within disciplines. It shapes what we look at, how we look at things, what we label as problems, what problems we consider worth investigating and solving, and what methods are preferred for investigation and action" (p.11). She further argues that positivism recognizes only facts and things that can

be observed and is not interested in the causes or origins of those same facts. She discusses the danger in quantifying human beings because that overlooks aspects of their lives that cannot be measured but may in fact be important. (Maguire, 1987).

Popkewitz (1984) describes a feminist paradigm as " a constellation of theories, questions, methods and procedures which share central values and themes. This constellation, which develops in response to historical and cultural conditions, provides a conceptual framework for making sense of the social world we create and live in". (in Maguire, 1987,p.10). Maguire (1987) describes a paradigm as "a place to stand" from which to view reality (p.10).

I have to say I have stood in many places along my journey to understanding what feminist research is and therefore I have done research from a feminist perspective rather than according to a specific methodology. When I first became involved in feminist issues I believed, as Tong (1989) outlines in her explanation of feminist theory, that women's place in society was determined by society's perceptions about women's roles. She argues that society's rules placed limits on the ultimate success that women could experience. I believed that if we could change the rules of the game to make it fair, women would have an equal chance of success. As such, I would have described myself as a liberal feminist. Experience has taught me that the solutions to women's oppression are much more complicated than simply providing a level playing field. I find it difficult to label myself according to popular feminist theories but I now believe that women's oppression is determined by the structures, beliefs and values of society and to change women's position we must change these structures to include

women's values and bring not only a dual perspective to society but also value multiple individual interpretations of that society. I now find myself closer to Tong's (1989) explanation of postmodern feminism. She states that "postmodern feminists worry that because feminism purports to be an explanatory theory, it too, is in danger of trying to provide *the* explanation for why women are oppressed or *the* ten steps all women must take in order to achieve true liberation" (p. 217) rather than exploring the idea of multiple truths and explanations.

How does this determine my current framework for feminist research? In part, I start by asking myself if I believe one of the solutions to women's oppression lies in changing a particular structure or belief of society. Then, what action can I take through my research that will lead to change, what methods will best serve that purpose and finally how will this change affect our present situation both individually and socially. The process becomes as Maguire (1987) describes it a method of investigation, analysis and action focussing on women's reality. This process of action and reflection is often referred to as feminist praxis (Maguire, 1987). Feminist praxis is a critical factor in the research process. It combines the creation of knowledge and understanding about our world with action.

I have relied on Maguire's (1987) framework for participatory research to guide the process of the Gender Inclusive Project. She describes it as her "feminist operating plan where continuous movement through the reflection-action cycle enriches the project" (p.5). Maguire encourages researchers to be explicit about their values and beliefs and to write in the first person so the reader can better understand the researcher. The structure of the chapters in this

dissertation have been organized to reflect this process of continuous movement through the reflection-action cycle. Each chapter begins with an assumption or belief that we held during a particular phase of the project. Some of these assumptions are based on our personal experiences and some are grounded in research findings. I have then discussed relevant research studies that have informed or questioned our assumptions and end with the actions we took based on those assumptions.

By linking the knowledge that exists in the literature with concrete action, participatory research removes the “traditional separation between knowing and doing” (Maguire, 1987, p.5). “It is a systematic approach to attempt to improve the lives of those involved in the research process and to transform fundamental societal structures and relationships” (Maguire, 1987, p.5). Hall (1982) explains that the “direct link between research and action is perhaps the most unique aspect of participatory research” (Maguire, 1987, p.29). He states that “participatory research aims at three types of change: the development of critical consciousness of the researcher and the participants, the improvement of the lives of those involved in the research and the transformation of fundamental societal structures and relationships. To accomplish these changes requires the direct involvement of the participants throughout the entire process” (p.29).

Whenever direct involvement of participants occurs, you must deal with issues of anonymity. To protect the confidentiality of the students in the gender inclusive project I have acknowledged their input by indicating only student response and their gender. The issue of anonymity for the teachers is more complex. Kirby & McKenna (1989) cite research that indicates that “anonymity is only a matter of degree”

(p.118). They state it is “imperative that the voices of the participants come through in the writing” (p.119). They offer suggestions for anonymity which include “changing names, places, age, gender and work” (p.119). They also state that researchers “may alter some or all of the situation, experience and time frame in an effort to provide anonymity” (p.119). The teachers in the gender inclusive project felt anonymity was not important to them. They decided that they preferred as close to a “real” account as possible. However, I have given the individual teachers pseudonyms and described them as a group rather than individually to afford them some degree of privacy. Any other references to people or places will also be fictitious.

The specific data collection tools and reporting of the results will appear throughout the dissertation. Although the gender inclusive project is a qualitative study focused on teacher change, we monitored student enrolment, achievement, learning styles and attitudes to ensure our strategies were not harmful to our students. On the following page is a time line that will outline some of the major activities that took place throughout the five years of the project.

FIGURE 1.0

GENDER INCLUSIVE PROJECT TIME LINE

1991-1992	1992-1993	1993-1994
SECURED FUNDING FOR PROJECT IDENTIFIED TEACHERS FOR PROJECT ASSESSED CLASSROOM ENVIRONMENT CONDUCTED INTERVIEWS WITH STUDENTS IDENTIFIED CONNECTIONS IMPLEMENTED WRITING-TO-LEARN	NEW VICE PRINCIPAL IMPLEMENTED COOPERATIVE LEARNING IMPLEMENTED SCIENTISTS IN THE SCHOOL OPENED MATH/ENGLISH COMPUTER LAB MATH PORTFOLIOS	NEW PRINCIPAL NEW VICE PRINCIPAL LIFE EXPERIENCES SCIENCE COMPUTER
1994-1995	1995-1996	
EXPANDED PROJECT THROUGHOUT SCHOOL IMPLEMENTED COMPUTERS IN MATH CLASS TEACHERS ATTENDED GORDON FOUNDATION CHANGE INSTITUTE	INTERNSHIP PROGRAM LEADERS OF TOMORROW PROGRAM ALTERNATIVE ASSESSMENTS NELSON HIGH CHANGE INSTITUTE MATH PROVINCIAL EXAMS WON THE ROY C. HILL FELLOWSHIP AWARD	

CHAPTER ONE

SCHOOLS AS A REFLECTION OF PATRIARCHY

The feminist challenge to the mainstream revisions and rewrites the future in ways that promise or threaten, depending on how one looks at it, the mainstream curriculum in fundamental, and not merely incidental or tangential, ways.

(in McCormick, 1994, p.84)

ASSUMPTION:

I started the gender inclusive pilot project based on certain beliefs and assumptions that I held about our present education system. One assumption was that schools, as does society, perpetuate patriarchal values of power and control and exclude and devalue women.

RELATED LITERATURE:

To understand the androcentric influence of education one must also understand it as a reflection of a set of beliefs, assumptions or values. Marilyn French (1985) states that "it cannot be expected that values dominant in the culture at large, will be lacking in education" (p.382). She argues that as a society, we view "masculine values as being directed towards power, control and domination and foremost amongst the values of a patriarchal system is the need for power and control" (p.70). She continues to argue that the educational system itself was "built on corporate and military lines, with centralized control administered through a bureaucracy: the one best system which is believed to work for everyone. The organization of this system contains and reflects its purpose; the control of many by the few, with control

of all layers of workers as well" (p.384).

Tong (1989) discusses French's (1985) work and agrees that it is likely that the more highly valued control is in a society, the greater will be its regard for males. "Based as it is on the value of power-over, by which French meant the domination of one group or person over others, the masculine world can accommodate only those values that serve to preserve its purpose" (p. 101).

MacKinnon (1987) argues that in "order to preserve the rightness of power-over, patriarchy must justify man's privileged status through the appearance of superiority based on gender difference" (p.8). She states that "in our culture, to give equal status to men and women is a contradiction in terms so long as gender is an expression of power relations and the male continues to hold power" (p.8). Adrienne Rich (1979) refers to this exclusion when she tells us that patriarchy occurs in any group where males hold power over women.

Catherine MacKinnon (1987) tells us that gender is a matter of "dominance, not difference" (p.8). MacKinnon goes on to explain that the subordination of women to men has nothing to do with difference. "There would be no emphasis on sex difference were it not for male dominance. The differences we attribute to gender are lines inequality draws. Inequality comes first, difference comes afterward. She also states that gender is an inequality of power, a social status based on who is permitted to do what to whom" (1987,p.8).

It should not be surprising to anyone that the values dominant in other patriarchal institutions also exist in schools. Robertson (1992) tells us that our schools teach, reflect and are sustained by androcentrism which imposes a particular paradigm; "a cultural filter

with three characteristics. Androcentrism requires us to see the world from the point of view of males, and to assume and assert that this is not a selective or limited perception. Androcentrism also requires the valuing of what is associated with men, including their work, experiences and values. Finally, androcentrism elevates male experience to universal experience and schools are explicit in maintaining this paradigm" (p.1).

Schools, like many patriarchal institutions, value power and control and practice the exclusion and devaluing of women. As Adrienne Rich has said "the content of education itself validates men even as it invalidates women" (1981.p.7). Robertson (1989) tells us that:

gender permeates our lives, our experience, our perceptions of reality and therefore our teaching and learning. Paradoxically, one of the characteristics of the social construction of gender has been the invisibility of this dynamic of gender, especially to those who find themselves amongst the most marginalized groups. The invisibility serves to distance the voices who would dare to challenge this reality. This marginalization can take the form of refusing to acknowledge the gender dimension of systemic discrimination, or sometimes it is validating only world views consistent with the dominant culture (p.1).

This exclusion has led to the silencing of women. MacKinnon (1987) in *Feminism Unmodified* argues that power constructs the appearance of reality by silencing the voices of the powerless. Heather-jane Robertson (1992) extends this principle by stating "it is thus the absence of questions of gender brought to bear on education generally, and school restructuring specifically which becomes the key issue" (p.2). Robertson (1989) cites MacKinnon (1987) when she "challenges us to become aware of the presence of absence" (p.2).

Charol Shakeshaft (1991) in "A Cup Half Full: A Gender Critique of the Knowledge Base in Educational Administration" argues there has always been a presence of absence. She argues that most of the work being done in organizational and administrative research is based on studies of white males. Dorothy Smith (1978) writes of this by stating:

Let us be clear that we are not talking about particular bias against women or as a negative stereotype of women. We are talking about the consequences of women's exclusion from a full share in the making of what becomes culture. We are talking about the consequences of a silence, an absence, a non-presence (p.283).

The androcentric influence of education is more than just the exclusion of women, it is also a set of beliefs or values. Weiler (1988) in her book *Women Teaching For Change* reviews educational theory and its assumptions. The first assumption she states is that "schooling is deeply connected to the class structure and economic system of capitalism. The second assumption is that capitalism and patriarchy are related and mutually reinforce one another. Men and women exist in interconnected and overlapping relationships of gender and class" (p.7). Weiler (1989) cites Althusser (1971) who argues that the "most important source of material and ideological practices exists in schools. It is through instruction and social relationships that students learn a way of being in the world and to view reality" (p.7).

Weiler (1989) goes on to discuss Wolpe's (1978) work where she states "as early as 1818, American legislators were being told that public education was the most humane form of social control" (p.33). Weiler (1989) continues her discussion of Wolpe's (1978) work stating she was one of the earliest contemporary feminists to address the role of gender in education. Weiler (1989) credits her critique of American

government policy statements on education and the effect they have on women. She states "Wolpe reveals the ideological assumptions about the role of women in society as wives and mothers doing unpaid work. The link she makes is the connection between patriarchal ideological views by men who controlled education and actual policy and practices carried out in our schools" (p.33).

Other researchers including Deem (1978) make the link between women's oppression in the workforce, society and schools. She believes there is statistical relationship between women's inferior position in the workplace and the experiences women have in schools. There are both overt and hidden agendas about women and their proper place within society and schools. Therefore, there is a connection between sexist practices in schools and women's oppression in society. Deem (1978) emphasizes that "schools transmit through their voice of authority different cultures and expectations to boys and girls. She states that schools provide a sort of training ground for patriarchy both in the subject matter and the ways in which we teach" (p.35).

As you can see some traditional educational theorists have seen schools as the means of preparing individuals to take their predetermined roles in what was considered a just society. Any reforms that were needed to the system were viewed as minor adjustments (Tanner and Tanner, 1980). When schools are criticized, it is assumed they failed to achieve their goals of reproducing cultural norms and standards.

The beliefs that we as a society and as individuals hold and the actions we take based on those beliefs shape our surrounding cultures. If as a society, we believe that attributes associated with men hold

more value, the actions we take will reflect those beliefs. In schools, some of those actions include how we teach, how we relate to students and what we include and exclude in our curriculum. This creates a school culture where certain groups hold more power and status. In schools, the student, the person for whom the structure is intended, has little power, and young women have the least of all. They are shuffled around in bureaucracy, as Hargreaves (1994) describes, "in a curiously fragmented experience, where bells sound every forty minutes signalling the changing of the guard" (p.44).

Every move a student makes is mandated for them including what they should think and what constitutes knowledge. Anne Seller (1988) cites Grimshaw (1986) to illustrate that point:

Theories, ideas and ideologies are not just ways of making sense of the world. They may also be the means by which one group of people may dominate or exercise control over another. (p.175).

What essentially defines feminist educational thought is its emphasis on empowerment and social transformation. Many feminists work not for equal status in an unjust system but the transformation of that system.

ACTION:

At the beginning of the chapter, I stated my assumption that schools elevate the masculine values of power and control to be universal and exclude and devalue women. Initiating the Gender Inclusive Pilot Project is my attempt to investigate whether that assumption is in fact true, and if so, is it possible to transform that system. After a discussion with the principal at my school I received

permission to apply to the Walter and Duncan Gordon Foundation for funding for the project. The next step was to find a group of teachers who might be willing to take on such a task. The principal and I discussed how to approach the staff about their involvement in the gender inclusive project. He suggested a pilot group of teachers. We discussed a list of potential teachers and agreed on the same three people. I approached those three teachers because the principal and I felt there might be some commitment to the issue of gender bias or at least some sensitivity to the topic. I was instructed by the principal not to approach the science department head but to leave all communication concerning the project to the principal. He felt there would be resistance from this individual and he would best be able to deal with any issues that might arise. I did not agree with this approach as I believed it would be better to deal with any potential conflicts openly but accepted his decision. I also discussed the project with the mathematics department head, who was quite supportive and quickly became a part of the group. Towards the end of the first year, the final member of the group joined the project increasing our number to five teachers.

The project teachers included three women (Deidre, Laura and Ellen) and two men (David and Richard). I, (Cheryl) had been released on a half time basis through the Gordon Foundation funds to coordinate the project. Four of the teachers have had teaching as their only career. Two of the teachers are close to retirement, two, including myself are midway through their career and the last teacher is one of the youngest members on staff. All of the teachers are from a Euro-Canadian ancestry. As a group we are quite diverse in interests,

talents and personalities. At the start of the project most of us knew very little about each other and did not have close collegial or personal ties.

Each of these teachers agreed to become involved in the project, but for a different reason. One teacher identified quite closely with the vision of inclusive education, one was looking for a new challenge in teaching, the third was concerned with the dropping enrolment in his class. The math department head was interested in what the project might add to her teaching and department. The youngest member of the group was looking for a place to share ideas. Below are excerpts from some of the teachers as they reflect on their initial involvement in the project five years later.

LAURA:

"I joined the Gender Inclusive Pilot Project two months after it was underway. I was invited to attend an inservice on writing in math and science. I felt this was something that I could implement in my classroom and so slowly I began to become involved and to involve my classes in several strategies that have now become the standard for the way I teach.

Why was this an important first step for me?... because it began to show me that many of the techniques that I had used in Junior High School because they were best suited to how my students learned, were also best for my Senior High classes. When coming to senior high I realized I had become a slave to the curriculum and time factors, especially in the 00 level courses. Getting back to many of the techniques with a new twist was exhilarating and very positive for me".

DAVID:

"I was looking for a new challenge/stimulus. I am also a firm believer in fairness. I wanted to find out if my classroom provided a fair atmosphere for learning. Initially, I had no conception of the issues involved. I just knew boys physically displayed high marks in class for others to see and girls hid high marks. Boys were noisy and vocal, but there was a gut feeling (not mine I must have absorbed it from somewhere) that girls who were vocal were somehow aggressive".

ELLEN:

"I became involved with the Gender Inclusive Project about four years ago because I wanted to find out what people in the project were doing. I came in open minded to hear new ideas. In isolation, I had tried things such as cooperative learning and writing in Math. I was willing to share my ideas with others (and to steal from them). It seemed that within the structure of the school day, there was little opportunity for sharing of ideas. I also felt that being involved with the Project, I would have an opportunity to attend professional development workshops and have access to resource materials".

We started the project with an initial meeting of the group where I outlined some of the issues that related to the lack of participation of girls in math, science and technology. I explained I was interested in investigating whether changing our teaching strategies and classroom environments would make a difference to young women. We also discussed the unique aspects of conducting a project using feminist research methods. David expressed concerns about not using a scientific method,

stating, "We won't be able to prove anything in the end if we don't follow traditional methods. We need a control group of students to compare results from different classes". I argued that "we shouldn't be treating students like rats in a lab experiment. If we found that our strategies worked should we deny those same strategies to other students because they happened to be in a control group"? Although Richard agreed with David, the other group members argued that they were interested in improving their classrooms not conducting an experiment. After further discussion, they all agreed teacher change would be the focus of our project. They also decided to try the new strategies with just one of the classes they taught. This would give them the opportunity to see if they noticed any differences between their project class and their other two classes. If they did, they had the option to expand their involvement in the project to include the other students.

At that first meeting, we also agreed that the approach we would take would be collaborative where we would meet on a regular basis to share information and plan our next steps. We also agreed that the participatory process would include a continuous evaluation of the project. Therefore, feminist praxis became a critical aspect of our work. The issues of collegiality and trust were also raised and all teachers were assured they would be in control of their classrooms and commitment to the project itself. We ended the meeting with a decision to conduct an assessment of our classroom environment and to continue ongoing education in the area of gender bias.

CHAPTER TWO

CLASSROOM ASSESSMENT

When teachers become aware of the nature and cost of sex bias in schools, they can make an important difference in the lives of their students. Teachers can reduce sexism in schools or even make it obsolete.

(In McCormick, 1994, p.52)

ASSUMPTION:

Girls, especially at the secondary level are largely ignored in our schools. Their lives are not included in the content of the curriculum or classroom discussions. They do not receive an equal amount or quality of attention from their teachers.

RELATED LITERATURE:

Over the last two decades there has been an ever increasing amount of research to document gender inequities in our schools. Sadker and Sadker (1986) tell us that gender biases are communicated many times each day to students in a variety of ways. This research indicates that schools tend to favour boys in every aspect of school life (Gaskell et al., 1989, Sadker & Sadker 1991).

Feminist researchers such as Jane Gaskell and Arlene McLaren (1987), editors of *Women and Education A Canadian Perspective*, document many instances of gender bias within Canadian schools. They provide evidence from The Royal Commission on the Status of Women's study on sex role imagery in Canadian textbooks which concludes that "a woman's creative and intellectual potential is either underplayed or ignored in

the education of children from the earliest years. The sex roles described in these textbooks provide few challenging models for young girls, and they fail to create a sense of community between men and women as human beings" (p.7). Other studies outlined in this book confirm this verdict. These studies tell us that "women are under represented in school books and when they are represented, they are stereotyped" (p.7). Although many of the newer textbooks have attempted to exclude obvious examples of sexism they still fall short of inclusion on an equal level. Nel Noddings (1992) states that "if women's culture were taken more seriously in educational planning, social studies and history would... instead of moving from war to war...give far more attention to social issues" (p.54).

The absence or silencing of women does not occur solely in the curriculum and textbooks of our schools. It is also a common theme in much of the feminist research on schools worldwide. *Gender & Ethnicity in schools* edited by Woods & Hammersley (1993) includes several studies from England which document that even early on boys have more interactions with teachers than girls and appear to be in contact with their teachers more often. Theresa McCormick (1994) supports this evidence by providing evidence that "American teachers spent 40% of their time with girls and 60% with boys" (p.26). She also reviews several studies that show that girls tend to volunteer answers less often in class than boys, prefer different learning environments and generally don't perform as well on standardized tests.

In Canada, Robertson's (1990) A Capella study of adolescent females documents many of these same gender inequities. One of the most common themes that emerged was that girls felt unheard and/or

misunderstood and therefore silenced. Below are just some of the girls' comments that illustrate that fact:

- “teachers don't listen... They intimidate students”
- “I feel very angry with the system and teachers when they disregard us”
- “teachers, are rude... They only have time for smart kids”
- “I'd like to talk to a teacher about a personal problem”
- “ Women teachers listen more”
- “ Equality within the system is a problem”

(Robertson, 1990, p.11)

A Capella also includes evidence from an American research study:

Whether one looks at preschool classrooms or University lecture halls, at female teachers or male teachers, research spanning the past 20 years consistently reveals that males receive more teacher attention than do females. Even in preschool classrooms, boys receive more instructional time, more hugs and more teacher attention. The pattern persists through elementary and high school.

(p. 68)

Most studies confirm that in mixed settings men speak more frequently and they are more likely to interrupt when a woman is speaking (Spender, 1982). Durost (1996) in assessing his math classes in Maine found similar patterns: “boys tended to answer questions immediately while girls were more likely to reflect. Boys tended to talk while girls were more likely to listen” (n.p.). Some of the current research on classrooms and teacher bias has been done by Sadker and Sadker (1989). They found that boys vocally dominate in the

classroom. "In more than one hundred fourth, fifth and sixth grade classes in four states they found that boys get more attention and encouragement than girls do. We found that at all grade levels, in all communities and in all subject areas, boys dominated classroom communication" (Sadker & Sadker, 1989 pp. 54, 56).

Davis, Steiger & Tennenhouse (1989) cite studies that indicate that males prefer to call out answers. They refer to research by Sadker & Sadker cited in Laforce (1987) that demonstrates that "teachers accepted the calling out of answers from boys rather than raising their hands" (p.4). They also cite Rich who states that "the male voice appears to be the dominant voice in the classroom and we have reason to believe that some women students will eventually sink into silence" (p.4).

ACTION:

The teachers in the pilot project decided the first step they would take was to assess whether our assumption that girls were largely ignored in their classrooms was in fact true. I developed a classroom environment/interaction checklist based on the factors that had been outlined in the research. I then visited each classroom for a 75 minute period on three different occasions to document classroom interactions. After my first few visits it was clear to me that some of the items on my checklist were irrelevant. I had included using stereotypical examples and sexist language on my list but the teachers in these classes very rarely talked about people or real life situations. This was quite surprising to me and gave me the first glimpse into how distanced math and science are from real life and personal experiences.

Below are the items and the results of the assessment for each of the original three teachers (Richard, David and Deidre). Total enrolment for their three classes is 79 students. The enrolment number on the chart indicates the number of male and female students in the class at the time of the assessment and also reflects the overall enrolment of those classes while ratio indicates the number of males versus females in the class.

TABLE 1.0
CLASSROOM ASSESSMENT

CATEGORY	TEACHER 1		TEACHER 2		TEACHER 3	
	M	F	M	F	M	F
RATIO (M-F)	1	1	1	2	3	1
ENROLMENT	15	15	11	22	12	4
TEACHER ASKS QUES.	23	10	28	16	22	6
STUDENT ASKS QUES.	12	3	12	6	28	2
FOLLOW-UP QUES.	17	1	5	2	22	2
INDIV. ATTENTION	16	8	16	12	10	4
STUDENT PRAISED	6	4	6	8	4	2
STUDENT CRITICIZED	5	0	8	0	2	0
CALLS OUT ANSWER	36	6	48	19	32	2
USES SEXIST LANGUAGE	0	0	0	0	0	0
USES STEREOTYPES	0	0	0	0	0	0

The results of our assessment indicate that there was indeed

gender bias in our classrooms. Before the assessment was undertaken the teachers strongly believed there would be no significant gender bias within their classes. The data, however, paint a very different picture. The initial reaction of the teachers was that the data had to be incorrect. They could not believe that they were unaware that boys were dominating in their classrooms. In some instances another follow-up was requested to confirm the results and in other cases audio and video taping was done to demonstrate that the results were in fact accurate.

This reluctance to accept gender bias within a teacher's classroom is confirmed by other studies done by researchers. Lanzinger (1993) in *The Canadian Woman Studies* discusses research where teachers believe that girls participate and are called on in class as often as boys. One of the studies discussed the inability of teachers to see gender bias within their classrooms. What explanations are there for the difference in perceptions and beliefs by teachers and the actual reality in their classrooms? Julia Stanley (1986) in her study "Sex and the quiet schoolgirl" argues that people have the perception that girls talk a lot. She cites several studies that found that "girls are not necessarily quieter, or better behaved than boys but their behaviour is a response to schools themselves. She tells us this quietness serves a useful purpose: of allowing them to shrug off parts of themselves as one might leave an overcoat at the door" (p.34). She quotes from research that echoes this thought when she tell us that:

Accommodation and resistance, even when it
takes the form of turning away or withdrawal,
is an active process

(p.41).

In her research, girls stated: "they did what teachers required of them; they were constantly asked to be quiet and wished to do well in school so took that advice literally even when it caused other problems for them" (p.46). The Sadkers believe that their research also indicates that schools give messages to students about their expected behaviour (1985). As well as conforming to the expected pattern of behaviour Stanley (1986) tells us the girls are also "adopting a stance which they see as appropriate for school. They adapt selectively to the circumstances of school as many describe themselves as being anything but quiet outside of school" (p.46).

Joan Draper's (1993) study on the reestablishment of gender relations after a school merger quotes researchers who have documented that:

many young women are being subjected to pejorative treatment for speaking out in class. Girls were barked at in the corridors and received verbal abuse. Many were taunted and jeered by boys if they spoke up in class or greeted with sighs and groans or phrases such as: shut up or O God not again and called squares or teachers' pet. This tells us that girls across the whole ability range have to put up with abuse, usually directed at anatomical references

(p.54-55).

The attitude of young men in schools is not the only problem. Teacher attitudes also play a large role. French & French (1984) in "Gender imbalances in the primary classroom" provide evidence that tells us "that teachers have a general and overall preference for male pupils" (p.96). They found that "generally in teacher-class discussions it is the responsibility of the teacher to allocate turns. Teachers seemed to prefer calling on boys and in particular one or two boys in

the class" (p.96). Davis, Steiger & Tennenhouse (1989) cite research that indicates that "so powerful are the forces at work, that American researchers have found that even teachers who identify themselves as feminists are unable to accurately assess the relative frequency of boy-talk and girl-talk" (p.6). They tell us from their own work that "however important a non-sexist attitude may be in terms of creating a nonsexist environment in the classroom, non-sexist attitudes may, in themselves, not be sufficient to ensure equal treatment for female students" (p.6).

We found some evidence in our own pilot project to support this theory. Teachers were unaware of their own gender bias previous to the assessment. They volunteered that their actions may have been an unconscious attempt to control the boys' behaviour by keeping them involved in the class or possibly that they tended to stand nearer to the boys to exercise proximity control which would partially account for them receiving more attention. McCormick, 1994 argues that:

the classroom teacher plays a significant role in the experiences and socialization process of the boys and girls in their classrooms. If the teacher calls on boys more, asks boys higher-order questions, and gives them more positive and definitive feedback and praise, while giving girls less, ignoring them, asking them lower-order questions and responding with more general feedback, the teacher is reinforcing sex-role expectations for females to be passive. These expectations can have direct bearing on their aspirations, self-esteem, achievement levels, career options and later choices in life

(p.26)

Kelly & Nihlen (1981) also point out that there are fewer young women enrolled in math, science and technology and there is a greater tendency for teachers to ignore young women in these subject areas.

During group discussions of our classroom assessment we discovered

that the largest disparity occurred when students were allowed to call out answers. The calling out of answers was dominated by two or three specific males in each class. This finding has been supported by similar results in the study done by French & French (1984). In their study, they found that "some boys take fewer turns than some girls and the imbalance between boys and girls rests largely with a subset of boys" (p.97). They go on partially to explain this "as some boys receiving a series of follow-up questions to their initial response and girls and other boys do not" (p.97). Sadker and Sadker (1987) also tell us that an "intellectual exchange between the instructor and students occurs most frequently with white males, with decreasing amounts and quality of interaction and exchange with the following groups in descending order: minority males, white females and minority females" (p.26). The American Association of University Women (AAUW) report (1992) identified biased teacher behaviours as a significant factor in the gender gap in science and mathematics:

Two recent studies find teacher-student interactions in science classes particularly biased in favour of boys. Some mathematics classes have less biased patterns of interaction overall when compared to science classes, but there is evidence that despite the more equitable overall pattern, a few male students in each mathematics class receive particular attention to the exclusion of all other students, male and female.

(AAUW,1992, p.70)

This apparent hierarchy in the classroom helped explain to us at a later date why the strategies that we implemented to ensure girls could speak also benefited many of our minority or quieter boys.

When the teachers went back to their classes, they were able to alter the amount of attention students were getting almost immediately.

They ensured that everyone was allowed the opportunity to speak by structuring the ways in which students responded. For example, once a question was asked the students were instructed to think about their answer first before they responded, allowing the girls and quieter boys time to formulate their responses. Another method was to alternate between the boys and the girls, another was to go up and down the rows ensuring each student had an opportunity to answer. Once, the teachers became aware of the disparity of contact time in their class and had specific strategies to deal with it, they were able to adjust the amount of contacts between males and females to a ratio of 1-1 almost overnight.

At first we thought adjusting the ratio of talk time was a success. Although these strategies significantly altered the opportunity to speak, they did not address the issues surrounding why girls and some boys chose not to participate. In many of the follow up visits that I paid to our classrooms, I noticed that the girls made every effort to avoid being called on by the teachers. In some cases their avoidance strategies included shrinking in their seats or hiding behind their textbooks. We discussed as a group the need to be sensitive to the obvious desire of some girls not to be singled out in class and made the decision not to call on some of these girls simply in the interests of trying to balance gender participation in the classroom. This did raise other questions for us, such as, how do we include and encourage young women who so obviously wish to avoid being a part of the classroom discussion and what was more harmful: their exclusion or their obvious discomfort? The specific strategies we used to address these issues will be discussed in a later chapter.

The next step in the gender inclusive project was to probe deeper into the reasons why girls were not speaking in class and seemingly choosing to avoid math and science. A decision was made by the group to conduct interviews with the students about this issue and what other factors associated with math, science and technology make girls feel uncomfortable in class.

CHAPTER THREE

GIRLS IN MATH, SCIENCE AND TECHNOLOGY

Mathematics is intrinsically beautiful, it has a rhythm and a pattern all its own. Why did someone not tell me this before? At the time I was in school the subject that was to be the key to my future seemed boring and useless.
(unknown source)

ASSUMPTION:

In addition to feeling silenced, young women may experience other factors in our math, science and technology classes that contribute to their low participation and achievement rates.

RELATED LITERATURE:

The lack of participation of females in secondary math, science and technology classes has been well documented in the research. Editors Gaskell & McLaren (1987) include several researchers such as Mura, Kimball & Cloutier (1986) who have found in studies on enrolment that consistently fewer young women enrol in elective high school math and science courses than young men. Robertson (1992) in *The Better Idea Book* (1992) has documented a similar pattern across Canada. She found that participation rates for young women in grade twelve math courses range from a low of 22% in Prince Edward Island to a high of 50.9% in Saskatchewan. In grade twelve physics classes the percentages range from 7% in Nova Scotia to 45.1% again in Saskatchewan. Statistics in computer classes were more difficult to find as many provinces did not track enrolment in this area: however, British Columbia registered 17% female enrolment in 1990 and Manitoba averaged 23%. These rates become

even more disturbing when you consider that women make up approximately 52% of the population and also have higher retention and graduation rates than men.

You will find a table on the next page that depicts the enrolment figures for young women in Manitoba, the year previous to our initiating the gender inclusive project. The table also indicates the base line data or initial enrolment rates for our school the year the project began. The Manitoba enrolment comes from the Curriculum Branch of the Department of Education and Training, Province of Manitoba (1990). The baseline data for 1991 was supplied by the Research Department of the Winnipeg #1 School Division. In Manitoba, science is a compulsory subject until the grade 12 level. Many young women when forced to take science have historically chosen biology or other life sciences. Math 300 is the highest level math course offered at the grade 12 level. For the purpose of this study, we have focused on tracking the courses that young women at our school and provincially are least likely to enrol in; namely physics 300, math 300 and computer science 305. These options also reflect the subjects that are considered the critical filters when choosing science or technology as a career. The total enrolment of grade 12 students in our school in 1991 was approximately 300, with males comprising almost 53.0% of our school population. The numbers of students enrolled in each subject at our school in 1991 was: math (158), physics (76) and computer science (10).

TABLE 2.0
ENROLMENT PERCENTAGES FOR MALES AND FEMALES

COURSE	<u>MB. 1990</u>		<u>OUR SCHOOL 1991</u>	
	M	F	M	F
MATH 300	52.0	48.0	55.0	45.0
COMPUTER 305	77.0	23.0	95.0	5.0
PHYSICS 300	64.0	36.0	77.0	23.0

Mura, Kimball & Cloutier (1986) tell us that "to explain discrepancies in male/female enrolment, some researchers have examined differences in mathematics achievement and enrolment" (p.133). Pieterston & Geddes (1993) cite evidence that argues for the biological superiority of males, differences in socialization, confidence or inadequacies of women in general. The results of these studies provide conflicting evidence. Mura, Kimball & Cloutier (1986) in their work on Canadian schools, quote several authors who tell us that:

until the age of 14, few sex-related differences in mathematics achievement are found. When differences are found, girls sometimes outperform boys, especially in tests of calculation skills. In high school, things begin to change. Differences begin to occur on standardized tests. We learn that males tend to do better on standardized achievement tests which measure learning outside as well as inside the classroom. On tests that measure mathematics skills learned in school (e.g. geometry proof writing) no sex-related differences are found. Also, studies of math grades as opposed to math aptitude tests show that females perform as well as or often higher than their male peers.
(p.133)

There is also conflicting evidence from the field of science. Eve Humrich compiles evidence in "Sex Differences in Science Attitude

and Achievement" (1992). She reports "that general intelligence is the same for males and females" (p.7). She argues that "sex differences in science achievement are situation-specific. It also tells us that sex differences are minimal in early childhood, but become apparent at adolescence and increase as grade level increases. When science data is analyzed you find small sex differences at age 13 and younger and upon analyzing the same data for 17 year olds, discover significant sex differences in science achievement" (p.7).

Listed below are the achievement rates for the pilot project taken from our division's research department for the year 1991; they represent the scores of the 244 students taking these subjects. A discussion of changes in achievement scores will be discussed in the chapter on student outcomes.

TABLE 3.0

MEAN SCORES IN PERCENTAGES FOR MALES AND FEMALES: OUR SCHOOL 1991

<u>SUBJECT</u>	<u>MALES</u>	<u>FEMALES</u>
MATH 300	55.0	55.0
COMPUTER SCIENCE 305	61.0	79.0
PHYSICS 300	68.0	61.0

What reasons do researchers give for conflicting evidence on achievement levels? Humrich (1992) indicates that some researchers cite "hormonal or biological explanations for these differences" (p.8). Ruth Bleier (1986) tells us that:

over the past two decades, research in this area has accumulated an enormous amount of scientific literature

on gender differences. Much of this literature attempts to explain observed differences in social roles. Neuroscientists have looked for the biological bases for gender differences in hormonal effects on the developing brain and differences in brain hemispheric lateralization. The focus in hemispheric lateralization has been on cognitive processing. The predominant theory has been that women tend to use the left side of their brain in addition to their right hemisphere in visuospatial processing

(p.147).

Gorman (1992) in her article "Sizing up the Sexes" concludes that women tend to be less specialized than men in processing visuospatial information. She quotes researchers who speculate that the "greater communication between the two sides of the brain could impair a woman's performance of certain highly specialized visual-spatial tasks. For example, the ability to tell directions on a map without physically having to rotate it appears stronger in those individuals whose brains restrict the process to the right hemisphere" (p.40). Some research studies indicate this ability is more prevalent in males and therefore support a biological reason for men excelling in math. However, studies on other areas of the brain, those most related to language development tend to favour females. If we were to apply the same logic we could assume that women would dominate such fields as law, politics and psychiatry where communication skills are critical; but they do not.

Gorman (1992) states that when "one asks the question which is more important, nature or nurture, the gender scientists have been unable to supply us with a definitive answer" (p.40). She indicates evidence from other research that "nothing is equal, even in the beginning" (p.40). Some research she cites has demonstrated that it is "possible to reverse some inequities by manipulating the environment.

Female rats have fewer nerve connections than males into the hippocampus, a brain region associated with spatial relations and memory. When their cages were enriched with stimulating toys, the female rats developed more of these neuronal connections. She states that although hormones do affect things it is possible to change the environment and enhance a person's abilities on certain tasks" (p.40). Humrich (1992) cites evidence that differences between men and women in some areas of mental abilities has decreased. According to many of these same researchers there has been little agreement amongst gender studies. Bleier (1986) argues that "the field is fraught with unexamined or untested assumptions, with inconclusive and contradictory findings and misleading interpretations that have been incorporated into our belief systems" (p.147).

Researchers such as Chipman & Thomas (1987) in their review of studies of sex and gender differences suggest that we refocus our attention away from sex differences to more important questions. They suggest research needs to be conducted on the ways we can change the factors that may inhibit women from making the choice to pursue math or science.

To accomplish this, Eccles (1987) tells us to examine the differences in interest in math and science. She points out that girls engage in a different decision making process than boys. She indicates that decisions are based on what we are better at and what we enjoy. She suggests that we adapt our classrooms to better meet the learning requirements of young women. She encourages us to individualize our instruction, provide opportunities for hands on activities and encourage young women to speak in our classes.

Humrich's (1992) analysis of sex differences research states "we should consider the fact that girls mature earlier than boys and introduce real science at an earlier age" (p.8). They state that "by waiting until high school to introduce science courses, girls are being shortchanged. Science in many areas is not taught as a specialty subject in the elementary grades and instead introduced at about age 14, when many researchers consider girls become increasingly aware of their social roles" (p.8). Haertel et al (1981) have also suggested that "adolescent girls are anxious to fit in and be feminine and therefore avoid math and science courses as they are perceived to be masculine" (p.9).

Researchers have documented that adolescents often experience a decrease in confidence and self-esteem but for young women this time is particularly difficult. The study done by the American Association of University Women, "Shortchanging Girls, Shortchanging America" (1992) drew attention to the relationship between self esteem and math and science. The AAUW study indicated that adolescent girls experience drops in self confidence and are less likely to express that they like math and science than boys.

Bower (1991) reviews some of the research affecting young women's self esteem. He argues that the "concept of self-esteem itself remains vague" (p.184). Bower states that this view "has been supported by the Harvard Medical School Mental Health Letter" (p.184). Some of the researchers in Bower's article assess a person's global self-esteem with questions about general feelings, while others focus on people's evaluations of themselves in specific situations. He notes that a person might score high on one type of inventory but low on another. In

addition, he argues that "high test scores could be an indication of conceit and narcissism rather than healthy feelings of self-worth" (p.184). Bower describes a statistical comparison of 93 independent studies which tell us that "gender differences in well being, an aspect related to self-esteem, also proves difficult to study" (p.186). He states that "if females generally show more sensitivity to and awareness of emotions than males, they may more easily offer self-reports about negative feelings creating a large gender difference in self-esteem. However, studies charting the self-esteem of students from grades 6 through 10 amongst 1,000 students and reported a gradual increase in self-esteem until grade 9 and then young women experienced drops in feelings of confidence and self-satisfaction" (p.186). This would agree with the work by Gilligan, Lyons & Hanmer (1990) that shows adolescent girls value intimacy with others and that large schools are an impediment to creating close relationships.

Although the lack of participation by young women is often attributed to the inadequacies females have, none of this research has provided a complete answer to the question why women do not participate in math, science and technology at the same rate as young men. We do know that the solutions prescribed for this question have often been remedial in nature. Holland and Eisenhart (1990) argue that studying participation rates is not the answer. They believe it does not give us the complete picture as to why women suffer inequities in the math and science fields. Their research found that female students' academic contributions were not accorded the same status and that individual female students were not encouraged in their work. Gilbert and Pomfret (1991) in their analysis found that women are capable of doing science

but do not feel comfortable in its male dominated surroundings (CTF,1992).

Chavarria (1993) in her work describes how science has always reflected male experiences. She deals with the issue that "math is socially constructed" (p.1061). She goes on to argue that "facts in math are considered to be truths and that these truths are considered to be objective, value-free, universal and independent of any context" (p.1062). Ursula Franklin (1991) also tells us that:

once we recognize the link between knowledge and understanding, we also recognize that knowledge is not neutral, objective or value free. It is impossible to assume that science, technology, mathematics or any other knowledge seeking activity is neutral because search, selection and construction of new knowledge begins with questions, and questions arise in a given setting. Questions make sense only in a particular social and political context and scientists are the socially sanctioned fact makers. However, these scientists constitute a small homogeneous social group which in the past was almost entirely, male, white and schooled in similar settings using similar texts. Yet, as their insights and the results of their research become facts, they have shaped society.

(in CTF, 1992, p.7)

Evelyn Fox Keller (1986) expands that theme when she argues that modern science is a culturally specific activity. She tells us that what is valued in science is determined by when and where the science was conducted.

Harvey (1991) in her research tells us our world has always been male dominated. She states that because men have held positions of power. What we study, value and record is a product of their experiences. Women soon learn that these experiences do not relate to their world and begin to avoid math and science education. Another

aspect of the masculinity of science is the notion of conquest. These ideas were expressed early on by Francis Bacon and Rene Descartes (Bleier,1986). Bleier (1986) writes that "Bacon's influence on moulding science in the image of men and masculinity was considerable and long lived" (p.6).

This masculinity extends to labelling scientific areas as either hard or soft depending on the status that the subject holds in the scientific community. One common description of physics is that it is a hard, intellectually difficult discipline as opposed to soft ones, such as biology. It seems the more mathematically inclined the science, the more intellectually difficult it is believed to be.

Schools often perpetuate these stereotypes. In some schools, math and science are portrayed as very difficult subjects. Strong stereotypes exist in our society regarding natural talent and who has it. Math and Science achievement are more often linked to natural abilities than any other academic subject. Furthermore, our society assumes that males have more of those innate abilities. The stereotype we have of math and science is one being devoid of people and feelings. In general, math and science has dealt with theoretical works with little practical application or relationship to the students' world.

What is this game that scientists play? They tell me that if I give something a push it will just keep on going forever or until something pushes it back to me. Anybody can see that isn't true. If you don't keep pushing, things stop. Then they say it would be true if the world were without friction, but it isn't, and if there weren't any friction how could I push it in the first place? It seems like they just change the rules all the time.

(In Rowe, 1990, p. 87.)

Chapman (1993) cites evidence that "in subjects like mathematics, word problems generally deal with the male world. Consequently, young women who prefer situations involving interaction with people, find them not only impractical but difficult to interpret or understand because of their limited experience in those areas" (p.713). Chapman goes on to cite Belenkey et al (1986) where she states that "connected learning has been promoted by some math educators" (p.713) and Buerk (1986) "as a way of understanding the inherent discrimination against young women in the way mathematics is taught" (p.713).

Chapman (1992) also tells us that "her experience with female students in math class led her to believe that many of them were engaging in a process, when solving word problems, that conflicted with those traditionally accepted in math. They would base problem representation on contextual details, recall specific details as opposed to structural features of problems and make judgments based on non-mathematical features. The traditional cognitive framework of math was not capturing social experiences that seemed to be influencing their treatment of word problems" (p.713).

The idea that young women solve problems in a different way to young men is not new. Belenkey et al (1986) support Gilligan's earlier claim that a majority of teenage girls base their decision-making on a moral psychology that differs from young men. This moral psychology stresses an ethic of caring for people. If young women approach problem solving in a different way than young men, are there also fundamental differences in their learning styles?

Learning styles have been described as the unique ways in which a person gathers and processes information and the ways by which they

prefer to learn. One of the best known methods for measuring preferred learning styles is the Gregorc Style Delineator (Gregorc, 1984).

Gregorc proposes that everyone has four abilities that influence their learning style. He divides these abilities into two areas: concrete versus abstract thinking; and sequential versus random thinking. These four styles are briefly outlined below as taken from Ryba & Selby (1993):

CONCRETE SEQUENTIAL (CS)- "This style is characterised by methodical, deliberate, step-by-step thinking. Individuals who have a preference for the CS style tend to learn best in situations that present information in an orderly and efficient manner. They prefer clear and well organized directions within a quiet atmosphere. Mathematicians and Scientists" (p.35).

ABSTRACT SEQUENTIAL (AS)- "This style is characterised by a preference for abstractions, thoughts and symbols. Individuals who prefer the AS style enjoy structured learning that is full of details and rich in images. Historians" (p.35).

ABSTRACT RANDOM (AR)- "This style is characterised by a tendency to experience the world of reality through emotions, imagination and feelings. Individuals who are dominantly AR are highly intuitive and grasp the essence of ideas building themes as they work through information in a random fashion. They prefer to work in an unstructured manner through group discussions. Artists, musicians and English majors" (p.35).

CONCRETE RANDOM (CR)- "This style is characterised by a preference for experimentation and investigation using the physical world as the laboratory. Individuals who prefer the CR style tend to be intuitive, instinctive, impulsive and independent. They learn best in an environment that is stimulus rich, where they can explore ideas and express opinions. Rebels, risk takers and entrepreneurs" (p.36).

ACTION:

The teachers in the pilot project began to question whether differences in learning style, moral reasoning and the importance of relationships could be some of the other factors that affect the enrolment and achievement rates of young women in math, science and technology. The spring term previous to our initiating the gender inclusive pilot project our teaching staff attended a seminar on learning style based on the Gregorc model. The teachers were quite intrigued with this concept and questioned whether the difference in participation and achievement levels in math and science was a gender issue or a difference in learning styles. To investigate this possibility we decided to test the learning styles of the students in our pilot classes through a variety of methods including the Gregorc Style Delineator.

Although the Gregorc Style Delineator is intended for use with adults and is not recommended for use with high school students we decided to administer the test for three reasons. First, the teachers were curious what learning styles their students would have in comparison to their own. Second, we had adult students as well as many eighteen year olds enrolled in our pilot class so we felt that the test

may be applicable with our population. Finally, Ryba & Selby (1993) had attempted to adapt the Gregorc to test their students in New Zealand and felt it had been successful. We did adapt the test somewhat by providing students with the meaning of some of the words on the test. We realize by doing this we cannot make any statements about the validity of the test as it was not designed to be used in this manner. We did find some interesting patterns in the test scores included below.

The first set of figures represents the learning styles of the 79 students in our grade 10 and 12 project classes by percentages.

TABLE 4.0
GRADE 10/12 STUDENTS BY GENDER AND STYLE
D.M.C.I. 1991

	<u>GRADE 10</u>		<u>GRADE 12</u>	
<u>STYLE</u>	<u>FEMALE</u>	<u>MALE</u>	<u>FEMALE</u>	<u>MALE</u>
CS	17.0	15.0	8.0	23.0
AS	3.00	26.0	18.0	36.0
AR	65.0	42.0	72.0	21.0
CR	15.0	17.0	2.0	20.0

One of the questions the pilot project group asked at the seminar they attended on learning styles was whether there were any gender differences. The response given by the seminar leader was "in the thousands of tests they had conducted they had found no gender

differences". The results of our students intrigued the group for a couple of reasons. At the grade ten level there appears to be little gender difference except for the Abstract Sequential and Abstract Random categories. The grade twelve results are quite different. We see the boys' percentage increasing in the CS or math and science related learning style and the girls' percentage decreasing. We also see continued increases in AR or intuitive learning style for girls but a decrease of 50% in the boys' scores. Finally, in the CR category of the risk taker we see the girls' scores have almost disappeared to a score of 2% while the boys' scores increase somewhat to 20%. This data sparked much debate about what this might mean. In the end we felt that the differences in the choices of learning styles for young men and women between grades 10 and 12 closely followed the literature on the effects of the socialization process. It seems that fewer young women see themselves as rational, objective (CS) learners or risk takers (CR) by the time they reach grade 12. Conversely, fewer boys seem themselves as intuitive (AR) thinkers and become more concrete sequential. After much discussion we decided that due to the adaptation of the test we were unable to make any statements about what this might mean. However, we thought there was a very good possibility that the students had described their learning styles according to gender stereotypes. This in itself was quite interesting to us and led us to attempt another style analysis at a later date in order to explore this possibility further.

As we continued to investigate the literature on learning styles we found that we were not the only ones to discover gender differences amongst our students. Ryba & Selby (1993) quote recent research that

also found significant gender differences in learning styles. They found significant correlations between learning styles and performance by college undergraduates in a computer applications course using the Gregorc Style Delineator. The results from Ryba and Selby (1993) indicate that boys and girls differ significantly in their preferred style of learning. They found that boys are more likely than girls to prefer a Concrete Random style and that girls rated themselves significantly higher than boys on the Abstract Random style. The Abstract Random style is characterised by emotional, perceptive thinking processes. The focus of attention for learners with this style is on emotional attachments and relationships with other people.

In a study on learning styles and study habits at the University of Manitoba, Walker (1993) also noticed gender differences in both areas. Walker reported that males generally appeared to have higher "self-concepts when they self-classified their learning styles and preferences. Males were more likely than females to classify themselves as imaginative, as enjoying thinking of new ways of doing things (CR) and being factual and accurate (CS). Females were more concerned with "pre testing themselves and attending class" (p.4).

The next set of figures represents research that was conducted by Gregorc. These figures represent the overall percentages of students and teachers with particular learning styles in Gregorc's research and was provided to us at the seminar we had attended.

LEARNING STYLE DISTRIBUTIONS OF STUDENTS AND TEACHERS

TABLE 5.0

<u>STYLE</u>	<u>TEACHERS</u>	<u>STUDENTS</u>
CS	55.0	30.0
AS	10.0	10.0
AR	25.0	40.0
CR	10.0	20.0

It was no surprise to us that the majority of teachers describe themselves as CS learners. We had found similar results when our entire staff participated in the learning style assessments. What was also no surprise was that certain departments within the school were grouped by learning styles. Most of the CS learners on our staff came from the math, science, computer and physical education departments. The majority of AR learners were from English, Art and Music. The AS were History and Geography and the CR learners tended to be interspersed amongst the various departments.

Walker (1993) found significant differences between students in faculties similar to those of our teaching staff. Walker observed that "students in Arts preferred dealing in ideas rather than facts and that faculties such as Engineering and Science placed a very high value on facts" (p.5).

The next set of figures represents the learning styles of the teachers in our pilot project by gender and subject area.

LEARNING STYLE OF PROJECT TEACHERS SUBJECT AND GENDER

TABLE 6.0

<u>TEACHER</u>	<u>GENDER</u>	<u>STYLE</u>
MATHEMATICS	F	CS
MATHEMATICS	F	CR
MATHEMATICS	F	did not take test
COMPUTER SCIENCE	M	CS
SCIENCE	M	CR
COORDINATOR	F	CR

One math teacher and the computer teacher were concrete sequentials, but the science teacher, one math teacher and myself were concrete randoms. As we continued to work with each other, these learning styles also proved to be somewhat representative of our personalities, the level of control that was important to us in our classrooms and our individual ability to take risks.

As the pilot project teachers were still unsure what all this data might mean, they made the decision to explore learning styles further and administer one more test to the same 79 students. We selected a series of statements from "What's My Style" (Townsend, 1987) and administered this test soon after the Gregorc Learning Styles Assessment. Following are the results from this test.

WHAT'S MY STYLE

%AGE OF FEMALE AND MALE RESPONSES TO LEARNING STATEMENTS

TABLE 7.0

<u>LEARNING STYLE STATEMENT</u>	<u>FEMALES</u>	<u>MALES</u>
1. I CAN BEST REMEMBER:		
A) The things I read	9.0	34.0
B) The things I see	27.0	32.0
C) The things I talk about	64.0	34.0
2. I LEARN SOMETHING NEW BEST:		
A) If I learn it myself	32.0	48.0
B) I discuss it with a partner	59.0	0.0
c) I research it at the library	9.0	42.0
3. WHEN THE TEACHER IS EXPLAINING I:		
A) Prefer they hand out notes	18.0	18.0
B) Prefer they give us time to discuss	68.0	45.0
C) Prefer they lecture on the topic	14.0	27.0
4. I CAN REMEMBER HOW TO SPELL BY:		
A) The way the words sound	23.0	36.0
B) The way the words look	18.0	20.0
C) Writing them to see if they feel right	59.0	43.0
5. WHEN WORKING IN A GROUP I:		
A) Would rather be somewhere else	9.0	16.0
B) Usually take notes or record	14.0	7.0
C) Enjoy talking about the issues	77.0	77.0
6. AS A STUDENT I LIKE TO BE REWARDED BY:		
A) Positive written comments on my paper	98.0	80.0

B) A pat on the back	0.0	2.0
C) Verbal comments in front of the class	2.0	18.0
7. WHEN I RECEIVE MY REPORT CARD I:		
A) Compare my marks with the class	18.0	59.0
B) Only tell my close friends	68.0	32.0
C) Tell no one	14.0	9.0
8. When I have a good idea I:		
A) like to share it with the class	6.0	86.0
B) Tell one or two close friends	84.0	6.0
C) Keep it to myself	10.0	8.0
9. When given a problem I prefer to :		
A) Make a list of solutions and try them	0.0	34.0
B) Discuss the choices with someone	100.0	16.0
C) Try whatever comes to mind	0.0	50.0
10. If I don't understand something I:		
A) Raise my hand and ask the teacher	30.0	50.0
B) See the teacher alone later	20.0	25.0
C) Ask a friend for help	50.0	25.0

This test also gave us some interesting insights into the learning preferences of our students. A few things in particular stood out for us. The first observation we made was that the girls in our classes tended to choose the same option in each of the ten questions while the boys tended to select a variety of responses. As we look more closely at the options that the girls chose we begin to see two recurring themes. First, discussing and talking in class seem to be particularly important; questions 1, 2, 3, 5, and 9 illustrate that fact. Second,

the concept of personal relationships is also important as outlined in questions 7, 8, and 10. Given that our initial classroom assessments and the research literature in general tells us that young women speak very little in class and topics of interest to them are largely ignored, we began to understand how marginalized the girls were in our classes. This quickly led us to undertake one more assessment procedure; a series of interviews with our students. We decided if we were to make changes within our classes to include the girls we must first listen to their voices and hear their explanations for their absence from these courses.

I conducted a series of interviews with the 79 students in the project about their attitudes towards math, science and technology as well as the factors the students felt were most important for their participation and success in these particular subjects. See appendix 1 for a list of the guide questions conducted in the interview. Students were given the option to participate in the interview process and were assured that the choice not to participate would not affect their mark in these subject areas.

As in all classroom situations teachers exercise power over their students. Any interview process involves power differentials between interviewer and interviewee but especially in a situation that involves teachers and students. Oakley (1990) has suggested that traditional interviewing practice are not appropriate for feminist research. She argues that researchers should attempt to provide a non-threatening environment for their participants and minimize power differences. Every effort was made to ensure a reasonable level of comfort for the students. Sample interviews were tested on students with whom I had already established a level of trust to gain feedback on how they felt

about the types of questions being asked. The students were interviewed in small groups rather than individually to attempt to minimize the power differences between myself and the students as well as to provide an atmosphere where their individual responses could be validated by each other. They were also given the option of handing in anonymous written comments at a later time if they were uncomfortable speaking out during the interview. The students were instructed that they could refuse to answer any of the questions and could terminate the interview at any time. See appendix 2 for the instructions for the interview process.

The information from the interviews was transcribed by question and coded by common themes. As well, individual statements that provided insights into the young women's classroom experiences were highlighted. The validity of the information from the interviews partly rests with the interviewer's ability to establish an atmosphere of trust and sincere interest in the students' responses. Also, the ability of the interviewer to listen and to hear what the participant is saying is essential.

As I looked at the coded information, I began to see several themes. These themes included confidence and self-esteem levels, access, relationships and relevance. These themes were expressed in many different ways by the girls. Some said that although talking and discussing in class was very important to them, they do not participate in classroom discussion and asking of questions because they fear being laughed at by the boys or having an incorrect answer. Below, is a quotation from one of the girls I interviewed:

"My friends and I talk all the time, but it's hard in class. I'm always afraid someone will laugh at me.

Especially George he's always making fun of someone".

Many of the young women in the interviews responded that they would only answer in class if they were absolutely sure they had the correct response and even then were reluctant to share it with the rest of the class. The boys, on the other hand indicated that they enjoyed participating in the class discussion and having the correct answer was secondary to them in comparison to the opportunity to speak. This seemed to correlate with my classroom observations. There were many times that boys responded with incorrect answers or were not even entirely sure what the question had been. Conversely, I had observed girls hiding behind their textbooks in an effort to avoid being called on even when they responded with the correct answer.

The issue of self confidence was expressed in many ways, especially by young women enrolled in the computer science class. Many of these girls felt they were not smart enough to be in computer class or that boys were just naturally gifted in this area. One young woman stated that boys and girls have very different learning styles: "Boys are much more rational thinkers than girls, that's why they are better at computers. I have to work a lot harder just to keep up". Many young women expressed doubts about their abilities even though they were achieving high marks. One young woman told me she was dropping out because her marks were not high enough. When I pointed out she had the highest mark in the class she responded "but I'm not really very smart". I also heard several "We can but I can't statements". These are statements where the girls would tell me that women could be scientists or computer experts but it would not be possible for them. When pressed on this issue they didn't really have a specific reason, just a general

feeling that it would be too difficult for them.

Access, especially to computers, was identified as an issue for several of the girls. One young woman told me keeping up in computers was difficult because she didn't have access to a computer. Her family owned one, but its use was reserved for the older brother who was studying medicine. Some students felt that there were not enough computers available and the only free time open was at noon hour. They felt the boys monopolized this time and also explained it was kind of like being in a locker room. Also, several of the girls explained that lunch hour was the only time they had available to be with their friends and that was their priority. One student expressed it this way: "I don't have a computer at home and I have to use the computer at school. The only time I can do that is at noon hour and none of my friends take computers and that's the only time I can visit with them, so I'm dropping computers". Access can also be hampered by timetabling conflicts. One girl explained that she wanted to take computers next year but she couldn't fit it into her timetable because she also wanted to take data processing and they were scheduled opposite each other.

Relationships was another important theme. Many of the girls expressed a strong desire to take classes with their friends and if this meant choosing between a science course or a course their friends had chosen friends won out almost every time. Another relationship that seemed to be particularly important to them in school was the relationship between the young women and their teachers. All of the girls spoke of the importance of this factor. They stated the teacher was of primary importance to their staying in class and also affected how well they did. Some of the girls spoke of trying to please teachers

they liked by doing as well as they could in that class. Others cited unfavourable teachers as the reason they dropped the class. The gender of the teacher was irrelevant to them but the feeling of being cared about by the teacher was critical. Below is an excerpt from the interviews with students that illustrates that point: "It's really hard for me to learn if I don't understand the teacher but especially if they don't like me. It makes me feel uncomfortable, like I'm really stupid and I'm not".

Another critical factor that stood out in the interview process was the relevance of subjects like math, science and computers to their lives. When further discussion took place on this issue, they stated that they did not feel these subjects were a part of their world. When would I ever use this was a common theme amongst the girls. When asked what would make studying these subjects more relevant, almost all of the girls who participated in the interview process strongly identified the existence of three factors that were critical to them as learners. These have been grouped under the heading connected learning:

CONNECTED LEARNING

- Connection #1: The personal connection between themselves and the teacher.
- Connection #2: The connection of the subject material to their own personal lives.
- Connection #3: The connection of the subject to the world of the students.

The idea of connections is not a new one. Chavarria (1993)

discusses work by Belenky et al (1986) and Gilligan and her colleagues Lyons & Hanmer (1990). Chavarria states that "women learn in a feminine connected way. This does not mean that all women learn the same way or that men are excluded" (p.1064). She goes on to say that "in connected learning there is a need for confirmation of the power to learn, of belonging to a community, of being an intelligent, capable human being" (p.1064). Chavarria cites further evidence that tells us that "there is a need to relate what is learned to personal experience and to value this experience as important" (p.1064). She states that "connected learning teaches that the ultimate authority need not be external to the student and valuing personal experience and the intellectual capacity in an atmosphere of trust, supports the student's internal authority" (p.1064).

Belenky et al (1986) tells us that "connected learning is based on the conviction that the most trustworthy knowledge comes from personal experience rather than the pronouncements of authorities" (p.113). Connected learners try to understand ideas by relating them to personal experiences. Noddings (1984) tells us that "it does not involve projection but rather reception. I do not project, she says. I receive the other into myself, and I see and feel with the other" (1984, p.30). Belenky (1986) in her interviews with college women found that in connected learning women "opened up their minds to receive another's experience. One student describes needing to find some point of connection between your own experience and the experience of what you are studying" (p.118).

CONNECTED TEACHING:

Belenky et al (1986) cites evidence on connected teaching as well as learning. She refers to "traditional education as banking. The teacher's role is to fill the students by making deposits of information which the teacher considers to constitute true knowledge. The students' job is merely to store the deposits and draw on them at test time" (p.214). She goes on to say that in traditional teaching "the teacher in this situation takes few risks, composing their thoughts in privacy. The students see the end results of their thinking, but the process is hidden from view. Because teachers are in the position of power they risk turning their students' voices into echoes of their own" (p.215). This distancing of the teacher from the student is explained further by Rich, (1979) who tells us that "in academia, both written and verbal communication is such as to not only obscure the influence of the personal or objective but also to give the impression of divine origin" (p.144).

Belenky (1986) discusses several researchers' opinions about connected learning. She states that "as long as teachers hide the imperfect process of their own thinking and learning, allowing their students to glimpse only the polished products, students will remain convinced that only an Einstein could think up a theory" (p.215). She tells us this is especially true in math and science. Science is presented as objective truths or a series of undebatable facts. Belenky states that "the teacher is not indulging in conjecture but is telling the truth or as one student puts it, science is not a creation of the human mind" (p.215).

In Belenky's (1988) description, "the object of knowledge is not

the private property of the teacher. Rather, it is a reflection of both students and teachers. Both student and teacher engage in the process of thinking, and they talk out what they are thinking through dialogue. Through dialogue, the teacher-of-the-students and students-of-the-teacher cease to exist and a new team emerges: teacher-student with student-teacher" (p.219).

In traditional classrooms students struggle to see the subject through the eyes of the teacher. Connected teachers try to relate to each of their students and encourage personal knowledge. Noddings (1984) explains it this way.

Suppose, for example, that I am a teacher who loves mathematics. I encounter a student who is doing poorly, and I decide to have a talk with them. They tell me that they hate mathematics. I do not begin with dazzling performances designed to intrigue them or to change their mind. I begin, as nearly as I can, with the view from their eyes: Mathematics is bleak, jumbled, scary, boring, boring, boring. From that point on, we struggle together with it.

(In Belenky, 1986, p.224)

Noddings (1984) goes on to tell us that to establish caring relationships between teachers and students, "you do not need to establish a lasting, time-consuming personal relationship but to be totally and non selectively present to the student as they address you. The time interval may be brief but the encounter is total" (p.180). Below is an excerpt from Ellen as she reflects five years later on the importance of making those connections in her classroom.

ELLEN:

"Making connections with students, especially female students, made an incredible difference in student motivation. Simple things like

saying hello, sending a get well soon card, letting a student use my personal purple pen, or telling a joke (as bad as they may be) changed the atmosphere in the classroom. It was as if students were trying to be successful in Math to please me. One female student told me daily that she had completed her homework. I had not asked if her homework was complete nor did I have any doubt that it was complete. She just needed daily reassurance that she was doing a good job. The use of stickers and stamps really surprised me. It also seemed that the sticker or stamp was my personal approval of a student's good work. This seemed to be very important, especially, for the girls. In a portfolio notebook, one girl wrote that her goal for the next term was to get a "super duck" stamp. As time went on and students became more successful, their confidence levels rose and they started trying for themselves (internal motivation). It was extremely difficult for some students to reach this level in one semester. Some students return for reassurance until they reach a level of self confidence, others unfortunately get lost in the shuffle.

Making things relevant to the real world. I finally figured out what this means. The real world to a student is their world. Their favourite music artist or TV show. Down right silly things like using the same name over and over in word problems. That's the real world to a student. As I tried to link more and more examples to their world, I found that more hands went up, more eyes were watching, more things were happening in the classroom. These types of connections seem very important to female students. They reminisce about them and they tell their friends about them. I assume making connections must have some sort of impact on students if math comes up in discussion amongst

teenagers”.

There are many common themes among the literature on connected learning and what our students told us in the interviews. At first the teachers felt overwhelmed with the results of the interviews. They asked questions like: “Where do we start? How much time will this take? Will I lose control of my class if I establish closer relationships with my students”? Although I didn’t have all the answers to these questions the teachers in the pilot project decided that they would attempt to develop and implement teaching strategies that would make connections with their students. We recognized that each teacher has their own particular strengths and learning preferences so we agreed that each teacher would be able to make these “connections” in a way that was sincere and made sense to their own style of teaching and time commitment. We agreed my responsibility was to research possible strategies and assist each teacher in implementing ways to make connections in their classrooms.

CHAPTER FOUR

WRITING IN MATH, SCIENCE AND TECHNOLOGY

I've gotten to the point where I don't care about much anymore, especially school. There are more things than this class and school that matters to me. Things are piling up on me. I'm sure you've heard it all before, and other people have problems too, BUT these things in my heart are much more important to me than school. My heart is controlling my mind and it won't stop. I think I will finish this course with a decent mark but at least I will finish. Maybe it should have been me instead of Maria who dropped out. Oh well, sorry for telling you all this.

(female student's response)

ASSUMPTIONS:

The personal connection to the teacher is a critical factor for young women but there is little opportunity to establish this connection because teachers tend to distance themselves from their students. Since young women are reluctant to speak in class, writing may be an alternative way for female students to dialogue with their teachers.

RELATED LITERATURE:

McIntosh (1991) cites evidence from Davidson & Perce (1988) that states that "many schools are beginning to implement reading and writing across the curriculum. For subject areas like English and History this seems like a straightforward concept but for some areas like Science and Math the notion is quite foreign. The traditional view has been that students learn to write in English and to compute in mathematics classes and never the twain shall meet" (p.423).

McIntosh (1991) also tells us the "reason for this lack of enthusiasm or downright refusal in regards to writing has to do with the

way that it is presented to teachers. Often they are given the impression that they must teach writing along with their subject area and this thought adds an unbearable burden to the teaching of their curriculum content" (p.423). She suggests that we instruct teachers in writing techniques that can be utilized in their classes along with the teaching of math. McIntosh (1991) also cites evidence that "writing-to-learn can be incorporated as another teaching tool rather than an additional chore for the classroom teacher" (p.423).

Davis, Steiger & Tennenhouse (1989) tell us that "given that women do not participate as fully as men in the oral discourse of the traditional classroom, some method must be put in place to give them equal opportunity to take possession of their own learning. Writing to learn exercises help to equalize the language experiences of both male and female students" (p.37). Davis, Steiger & Tennenhouse (1989) draw on work by researchers who have shown that "students make sense of their education through frequent and shared experiences in writing to learn" (p.37). Most students never see how math or science is a way to make sense of the real world, and for girls and minority students the connection is even less evident.

For Countryman (1992) there are other reasons for implementing writing in the classroom. She tells us that "everyone can learn mathematics" (p.5). It is simply the way in which you approach the subject. Countryman (1992) cites evidence from the mathematics education reform movement that suggests that "for many years the teaching of mathematics has been based on the opposite premise: Either you get it or you don't" (p.5). She goes on to state that "students, even the successful ones, tend to define the subject area in rather

narrow terms. They see it as a collection of facts, rules, numbers, symbols and most importantly, right answers. Learning requires memorizing, listening quietly and following instructions. The rules and procedures make little sense to many students. They memorize examples, they follow instructions, they do their homework, and take the tests, but they cannot say what their answers mean" (p.5).

Burton (1986) cites evidence that lists the ability to communicate with others as one of the requirements for a good research mathematician. Countryman (1992) states that "knowing mathematics is doing mathematics" (p.2). She encourages us to "create situations where students can be active, creative and responsive to the world. They can do this by exploring, justifying, representing, discussing and using mathematics. Writing is an ideal activity for such a process" (p.2). Burton (1986) argues that if you connect writing and mathematics it gives students an entirely different way to look at the subject matter. She encourages teachers to explore as many forms as possible.

McIntosh (1991) provides evidence that "expository writing is defined as a form of writing whose primary purpose is to set forth or explain. Good exposition is clear in conception, well organized and understandable" (p.430). Countryman (1992) suggests that students would improve their expository writing skills if we linked their assignments to mathematics. McIntosh (1991) suggests this can be done by "designing expository writing assignments that tie in with course content. Once the students gather the necessary information, it can be integrated into various curriculum activities or presented on a bulletin board or within a portfolio" (p.431).

The process of writing can take many forms and serve many

functions. Expository writing may not appeal to all students so it is important to provide opportunities for other creative forms (McIntosh, 1991). She argues that "some students excel in literature but not mathematics, by appealing to these students' strengths and relating them to the area of mathematics may help them feel more positive about the subject area as well as enhance their performance" (p.432). She goes on to suggest a variety of forms that students can explore.

Writing-to-learn becomes a valuable tool for students to link theory with real life experiences. It is also useful for helping students to keep on top of their reading and to reflect on it, helping them pay attention in class and in some cases bringing them to class. For teachers, such writing assists them in finding out what is working and what is not in their classrooms. Through the various forms of writing-to-learn dialogues, teachers can begin to help students, especially young women, feel comfortable with the learning process. These dialogues also provide an opportunity for the exchange of ideas between teacher and student without the young women having to speak up in class.

ACTION:

Making connections with students had not been part of anyone's teacher training and so we continued to struggle with the issue of how to go about it. At this point in the project we were particularly concerned about the amount of teacher time that young women were receiving in their classes. Our student interviews had confirmed our assumption that young women viewed the relationship with their teacher as an extremely important factor in their school lives. Many of the

young women also expressed hesitancy about talking in class and so we felt that merely calling on them more often may in fact make them feel more uncomfortable. This led us to explore alternative ways of establishing dialogues with the female students in our classes.

I reviewed the research on writing-to-learn and then discussed it with the teachers. This technique seemed to be of interest, especially since the math department head had formerly taught English and could immediately identify with its potential. We decided to invite two of the authors from the research we had discussed to come to the school and work with us on how to implement a writing program into our math and science classes. Fran Davis and Arlene Steiger, (1992) two of the authors of *A Practical Assessment of Feminist Pedagogy* agreed to assist us and spent two days at our school discussing various techniques they had used in physics classes in Quebec. The teachers were instructed on various writing techniques and had an opportunity to participate in free write activities. We also discussed the benefits and drawbacks of using writing in a math or science class. Davis and Steiger spoke about the benefits of utilizing writing techniques in the classroom and also warned the teachers that it would require additional marking time to read and respond to the student writing. This raised the question of whether the writing assignments should be marked. Davis and Steiger suggested assigning a grade for participating in the writing but discouraged us from marking the student responses for grammar and spelling. They felt that editing the students' work would discourage the exchange of ideas between teacher and student.

At the end of our training session, the group agreed to focus on one of the techniques they had learned, that being the question and

answer box. The framework for the question and answer box as described by Davis, Steiger and Tennenhouse (1992):

requires students to write, once a week, one full page describing the exact nature of a difficulty they are having with the course or a particularly interesting idea or solution they have found. Articulating the question is particularly important: the process of putting the problem into words offers the students an opportunity to discover what it is they do not know or have not learned; sometimes the process can even permit them to discover their own answer. These articulations allow the teacher to see exactly where the students are in the learning process, and to make simple individual interventions, or to take student questions as starting points for review classes. Students' answers for the question and answer box could also be shared with the class. The question and answer box is designed to help students feel more comfortable about posing questions about their learning. It is also intended to create a much closer relationship between students and teachers, and allows the teacher to demonstrate in a practical way how interested they are in the students' learning.

(p.40-41).

In order to establish the connection between the teacher and the student the project teachers were trained by Davis and Steiger in a technique to respond to the students' writing. They were instructed to focus on three things. First, each response from the teachers must begin with the students' name. Although this seems like a small thing, it reassures the students that even though this is a large school with many students the teachers do in fact know who you are. Second, the teacher acknowledges the issue or problem that the students have written about, validating the students' concerns, questions or discoveries. Third, the teachers, where appropriate, include in their responses some examples of personal disclosure. Personal disclosure means that they let the students see themselves as real people. For example, if a student

writes that they have a particular problem with a section in math a teacher may respond "I also had difficulty with that section in math. Here is a technique that I used. Try it and if it doesn't work for you come and see me next class and we will discuss other possibilities you can try". In this way, students begin to see teachers as real people who may also have experienced difficulties in math. It is essential that these responses be true and sincere, otherwise the objective of establishing a trusting connection between teacher and student will be lost. Below, you will find some examples of student writing and the responses by the teacher. A copy of the handout describing the question and answer box that was adapted from the Davis, Steiger 7 Tennenhouse model is included in appendix 3.

FEMALE STUDENT:

"Hi! Mrs. Jones, how are you doing? About me: I'm surprised. I didn't expect that I was passing this course and now I'm very happy. I'm even going to try to get 70 if I can. I'm going to start by studying longer and doing my tests all over again.

Now I'm really liking Math, I also like going to the computer lab. You know my aunt and my sister help me with my math homework. Sometimes my sister is the only one that helps me. Sometimes my aunt is studying and doesn't understand her math so she doesn't have time to help me so I just ask my sister.

Anyway, about Nelson High. I really like it here. I have a lot of new pictures from my new friends. People here are really friendly and nice. They always let me cut in line when its lunch time. They are nice when they bump into me accidentally. They turn around and say they

are sorry, even though I don't know them. I don't know the grade 11's and 12's very well but even they say hello to me. I also like the teachers here, you really work hard. The only thing I don't like is going up to the board to do homework. I sometimes feel lost because I'm short and I don't like people staring at me. I know I'm putting myself down but I'll try not to anymore.

My question in math is about perimeter and areas from the test. I don't understand how to do this"?

LAURA'S RESPONSE:

"(Student's name): I'm glad you are pleased with the progress you are making in math class and have come up with a good plan for improvement. Keep it up! I see improvement in you each week. If you find your sister and aunt don't always have time to help you with your homework please ask me for help, O.K. I am really pleased that you like our school and are meeting a lot of friendly people"!

FEMALE STUDENT:

"My first month and a half here at Nelson High went pretty smoothly, I'm proud to say. I really didn't expect it. I expected something very different. I knew that I would have to face many new things, and that sounded very scary. After being here a month and a half everything seemed to work out fine. A couple of days ago, while I was sharpening my pencil at the sharpener I looked outside and I think that may have been the first time I realized that I was at Nelson High Collegiate Institute. Just the word "collegiate" sounds so superior and so big. I'm proud to be here. I like it here. I can't say that I

don't miss Britannia because I do. I know and knew that I had to make that step, that big step, but there will be many more big steps ahead which I will have to face and surpass to get ready for the life ahead of me.

Math: Just in this month and a half, we've learned so much Mrs. Jones. You were right when you said that missing a day of school would be crucial and would be hard to catch up. I can see why now. In my tests I seem to have some problems with the questions about "concept errors". After doing the corrections for the test together I think that maybe I actually understand it now. Corrections do help a lot. Thanks".

LAURA'S RESPONSE:

"(Student's name) I am very happy you are enjoying Nelson High. I'm also pleased you feel that you are handling the adjustment of a new school and you will find that you will be able to handle other challenges that come in your life as well. The fact that you have found going over your test corrections helps you is a useful skill for you to know. If you need additional help with any of the other sections please come and ask me".

FEMALE STUDENT:

"As you know, the last assignment (#4), really gave me trouble. I know how the IF's work but when setting up the information for what should go in the false range or even when to use Branches I don't understand how they function. It's setting them up and when to use them that is the problem for me.

Well, I've received my report card with my B+ in Computer Science 205 mark on it. I knew I was going to get that but I didn't want to believe it until I saw it. So, I'll pat myself on the back for it and thank you for your assistance. I really thought in the beginning of the semester that I was going to get a much lower mark. Seriously, I am proud. A B+ is a great mark in your class. Well let's hope I proceed to sustain that mark. I don't know this last assignment sort of knocked my hopes down a few notches! I wonder" ???

RICHARD'S RESPONSE:

“(Student's name): Computer Science is just like life - full of ups and down. And just like in life you have to keep plugging away in order to succeed. Remember that it is working through the hard times that builds character. I am proud of you too. The marks did not come easily. You worked hard for it and you deserve it. Overcoming obstacles comes more easily with experience.

For solving the branches, I always like to look at the tasks to be done, and once I have decided what they are, then I decide whether the task can be accomplished best using a sequence, a branch or a loop. If something has to be repeated, use a loop. If you have a choice of doing one thing or another, use a branch. You actually have to ask yourself these questions. If you can't decide what goes where, just write down what you think is correct, and then trace it. If you find a mistake in the trace, usually the correct logic will come to you when you find the error”.

The strategy of the question and answer box has proven to be

extremely useful to most of the project teachers for many reasons. The technique itself has a structure and timeline which appealed to the personalities and learning styles of all but one of the teachers. The teacher who found the question and answer box too structured implemented other forms of writing in the classroom which will be discussed later. The other teachers gained a great deal of information about their individual students and the class in general. This information included what areas of content students were having difficulty with as well as what they already understood. More importantly it gave the teachers an opportunity to get to know their students on a personal level, something that was missing when their focus had only been on covering content. All of the teachers felt these insights more than made up for the amount of time they had invested in the reading and responding to the questions.

We also used the question and answer box to collect information from the students in an evaluative way. Throughout the life of the project students were asked their opinions about the strategies we were trying and some of the changes that were occurring in their classrooms. We found this a particularly useful tool to gain insights into what the students thought and validated their concerns by implementing their suggestions wherever possible. Below is a short excerpt from a student where he gives his opinion about the question and answer box.

MALE STUDENT:

"In my opinion, the question and answer box was an excellent idea. It allowed me to ask questions which I was interested in but didn't feel comfortable asking in front of the class. I used it mainly to find out

about how computers related to the world and general technology. Your answers provided me with the information I wanted. There were sometimes when I felt more comfortable speaking to you face to face about something I had written about so I could emphasize my question in a better way. I definitely think the question and answer box should be continued next semester”.

One of the most important benefits of the question and answer box was to establish a personal connection between the students and their teachers. We initially assigned a percentage of their term mark for turning in the question and answer box but we no longer find this is necessary to motivate students to write. In fact, the more the teachers respond, the more the students, especially girls, write the next time. It is also quite interesting to us, that in many cases the students appear to guard their responses from their teachers quite closely rather than sharing them with other students. It seems that for the students, especially the young women, that this is their own personal communication with the teacher.

Although the teachers feel that students are more likely to approach them about personal difficulties, they initially had some concerns that the students' writing may become too personal. They stated that they were unsure of their ability to deal with that possibility. This only became an issue one time. In that one instance, the teacher handled the situation by writing his next response in a slightly less personal way and the student seemed to understand that they had crossed the bounds of what was acceptable and responded in an appropriate fashion for the remainder of the semester.

Over the course of the project we saw many examples of the importance of the question and answer box to the students. One morning, a teacher who is not part of the project commented how important the question and answer box activity seemed to be to a group of young women that she was supervising. The girls had come in early in the morning to play basketball in the gym. Part way through the game they decided to stop early and study for a test. As they were sitting studying at the side of the gym one of the girls inquired if another girl had completed her question and answer box. The girl replied that she hadn't. Immediately, the urgency of the test seemed unimportant and all of the girls joined in on the discussion of what would be written in the student's letter for that particular week.

Another example involved a young women from one of our first pilot project classes. She recently came back to visit the school and her math teacher. She had just been accepted to Queens University to study engineering. She was proudly relaying the news to her former teacher and shared this story.

"You know I never really thought I was good enough to take engineering, but your class made all the difference to me. Not only because you are a good teacher but because of something you wrote to me in my question and answer box. You probably don't remember, but you told me that I had the potential to do well in whatever I chose and that I should work hard and never give up. I still have that letter and over the last few years every time I was getting discouraged I would take it out and read it. It gave me the courage to keep on going".

Although the question and answer box proved to be a very effective tool to communicate with students, not all of the teachers in the project chose this strategy as a writing tool. One of the teachers was particularly interested in creating portfolios in her math class. Research done by Martin (1995) indicates that when students utilize portfolios they are better able to demonstrate their understanding of math and science. In her study, students were asked to submit portfolio entries to show a greater understanding of the material they were taking. The results indicated that female students obtained significantly higher scores on all segments of their work.

Journals are often used as a form of communication. One mathematics teacher states that:

writing is not a sure-fire way to help students understand or like math, but it does open up the lines of communication, and helps to build a sense of community and trust so that students can take risks. Mathematics, after all is communication, but communication in math involves, a compact, unambiguous symbolism that to many students is cold and rigid. Writing, on the other hand, is a less structured way of expressing ideas. Since writing in math depends on communication, I use it mainly as a way of opening up lines of communication.

(Schmidt, 1985, p.104)

Davis, Steiger & Tennenhouse (1989) cite evidence that "journals have been used frequently by feminist educators to help students make connections between affective and cognitive experiences" (p.38). They tell us:

journals require students to reflect on what they are learning. Students write reactions to what they are assigned to read; reactions to class instruction and media presentations. They can also be asked to deal with course content in cognitive ways through precis writing and composition of their own lecture notes. Although journals can function as learning logs, assisting

students to facilitate students' learning and to inform teachers as to the kinds of learning that is going on in their classroom, they can also serve to help students make sense of new ideas

(p. 38-39).

Ellen implemented portfolios in her class. She asked her students to include various forms of writing as well as concrete examples of tests and assignments that reflected areas where they were doing well or struggling. These were organized under three categories: Math in the classroom, Math outside the classroom and Self Evaluation. An example of the math portfolio information sheet is included in appendix 4, as well as an example of a more general portfolio assignment. One of the objectives of including expressive writings such as journals was to help the students make connections between their experiences in math and their performance. Another objective was to provide a more creative outlet than the question and answer box as a form of communication between the students and that particular teacher. Below is an excerpt of expressive writing in a journal assignment from one of the student's portfolio assignments. The students were asked to write about their math history.

MALE STUDENT:

"We had 4 huge steps which led up to the front door of our house, and as far back as I can remember I was able to count to four, (one, two, three four). I'm not sure if I knew I was counting or if I was calling the steps by their names. At what point in time I actually began to identify the various symbols that I saw on clock, calendars, books and everywhere is somewhat vague. Possibly it was a combination

of my parents and Sesame Street and, those magnetic symbols that I plunked on a board when I would be my sisters' pretend student. In any case adding was by far the biggest breakthrough for me, because up until then I never quite understood how my sister's equal share of Gummey Bears was always bigger than mine. For the most part everything has gone well for me in math, but now that I am in high school and dealing with more difficult concepts half the time I feel like I am counting huge steps all over again".

The journal writings that appeared in the students' portfolios served not only as an alternative form of assessment in mathematics but more importantly as a dialogue between teacher and student. These dialogues served as an opportunity for the students to express their feelings and experiences with the subject matter. When Ellen reads the math journals she learns more about what students grasp and do not understand, like and dislike than from more formal assignments. In addition, these journals allowed the students not only to express their ideas and opinions but also provided insights into their math abilities, thought processes and cognitive development as well as how they come to construct their knowledge. The journals helped students clarify their thinking about math. It also provided another vehicle to establish dialogues with their teachers.

ELLEN'S RESPONSE:

"Writing as a tool in the Math classroom allowed me to learn a great deal about my students (which I feel was especially important to the girls) and provided an opportunity for them to learn something about

me. The written explanations of math concepts also built a vocabulary and fine tuned understanding of those concepts”.

Throughout the project each teacher has utilized writing-to-learn activities within their classrooms. They adopted ones that seemed workable for their particular teaching style and their students' interests. They also had the freedom to establish the grading system, if any, that would be attached to the students' work. Although hesitant at first about the amount of time, work and usefulness of implementing writing as a strategy in their classes, all of the teachers would now agree that it has been a very positive learning experience both for their students and for themselves. The training sessions on writing provided the project teachers with an excellent start in adapting their classroom teaching strategies. This successful start made it easier for the teachers to risk trying other new strategies in their classrooms.

CHAPTER FIVE

DEVELOPING A COMMUNITY OF RESPECT

You are not being fair to me because you are not listening to what I am saying. I want to be treated and respected for someone who has their own views and values.

(female student)

ASSUMPTIONS:

Although writing to learn provides an alternative way for young women to express themselves and establish a connection with their teachers, it does not address the fact that many young women prefer discussion as a learning style or that they feel threatened or silenced in our classrooms. Cooperative learning might provide a more supportive learning environment for young women.

RELATED LITERATURE:

The disparity in talk time between young men and women and its effects have been well documented. Davis, Steiger & Tennenhouse (1989) tell us "that there is a persuasive body of knowledge developed in England and the United States, which emphasizes the critical function of language in the acquisition of knowledge" (p.5). They cite evidence that "emphasizes the role of talk as the means by which the teacher of mathematics can uncover the significance of error and help the student move towards understanding" (p.5). Davis, Steiger & Tennenhouse (1989) go on to state that "while the young women in our classes fare less well than young men in the competition for attention in the classroom, it is critically important to provide alternative ways for students to

become involved in class discussions and exchange of ideas" (p.6).

Burton (1986) argues that when young women do not participate in class they are in fact telling teachers that this is not a comfortable learning environment for them. She goes on to say that the way material is presented to students will have a significant impact on their ability to learn and negative messages are most often given to young women and minority students.

Davis, Steiger & Tennenhouse (1989) cite research that suggests that to address this problem "many feminists emphasize the establishment of an atmosphere of mutual respect, trust and community in the classroom" (p.9). They go on to cite research that suggests that "female students may be disadvantaged in situations where traditional pedagogical practices emphasize competition either in terms of performance in class or through evaluative techniques" (p.6). They go on to provide evidence that tell us that "real efforts are required to break down the hierarchy of the traditional classroom, in the interests of building an alternative learning community where cooperation replaces competition, and the collaborative qualities can be experienced as advantages" (p.9-10). Further research by Horner (1969) indicates that cooperative learning strategies are more conducive for women than the more traditional competitive ways. Tobias (1990) in her work also found that young men benefited from less competitive classrooms.

Most of the accepted cooperative learning strategies promote the formation of groups that are heterogeneous. Skolnick et al (1982) tell us that implementing cooperative learning classrooms provides opportunities for young women to speak and form relationships. They warn us that teachers need to pay attention to how groups are formed and

arranged in order to develop a sense of comfort within the classroom. They further state that "how and what children learn is affected by what happens in any social group. Unfortunately, our social arrangements sometimes negatively affect girls' learning in math and science" (p.53)

Davidson (1990) builds on this idea by telling us that effective cooperative learning classrooms rely on forming relationships within the groups. He argues that when students forge positive connections with other students it teaches them to be more tolerant and accepting of a variety of classmates. He tells us studies conducted as early as 1960 indicated that students who engaged in cooperative situations developed better social skills and understood the material they were studying better than students in more competitive classrooms. Cooperative learning provides "an avenue to maximize opportunities for talking and interaction. The collaboration that takes place in cooperative settings gives each student the opportunity to receive help in a private non-threatening way" (Skolnick et al, 1982, p.54).

Research also indicates that cooperative learning experiences in math and science classes can improve student attitudes towards their work. Cooperative learning strategies have been credited with the "promotion of critical thinking, higher-level thinking and improved problem-solving abilities of the students" (Dees, 1990, p.161). McCormick (1994) states that "nearly twenty years of research strongly suggests that cooperative learning encourages higher academic achievement and more positive social interactions" (p.64).

McCormick (1994) cites research by Johnson and Johnson (1981) who found that "cooperative learning in small groups helped reduce gender and race inequities in the learning environment" (p.64). Little Soldier

(1989), in support of cooperative learning for minority students, writes:

The potential benefits of cooperative learning for Native American students are clear. Cooperative learning appears to improve student achievement, and it also matches such traditional Indian values and behaviours as respect for the individual, development of internal locus of control, cooperation, sharing and harmony. Cooperative learning can improve the attitudes of students towards themselves, others and school.

(Little Soldier, 1989, p.163)

McCormick (1994) supports cooperative learning techniques as a method to address gender imbalances in schools. She tells us that "curriculum and instruction in schools are structured on a eurocentric and competitive model that values traditional male versions of knowledge and ways of knowing" (p.64). She sees "not only benefits to young women by integrating their female voice into the classroom but cooperative learning also provides opportunities for young men to benefit from exposure to the traits of care, support and collaboration" (p.64).

Cooperative learning itself does not address the unique aspects of female learning. Johnson and Johnson (1990) now tell us that simply placing students in groups and telling them to work together will not magically solve the problems related to how students learn. They tell us that you need certain conditions before group efforts may be expected to be more productive than individual efforts. These conditions are: "teachers must clearly structure positive group dynamics, students must engage in face to face interaction, students must be accountable for their work, students must learn and use interpersonal skills and finally teachers must ensure that the learning groups engage in regular group

processing" (p.105-106).

Traditionally structured groups where students are simply placed together often do not function effectively. Studies done by Lockheed & Harris (1984) in McCormick (1994) also tell us that "cooperative learning may not be a positive strategy for young women because of the social dominance by males in any size or type of group" (p.65).

McCormick (1994) cites research that "calls for further research into the area of cooperative and cross-gender learning because of the male dominance of communication patterns" (p.65). McCormick (1994) would also caution us that cooperative learning is not the only answer but encourages us to consider that cooperative learning can be used to promote student ownership of their learning. To overcome some of these concerns Scott (1985) suggests:

that teachers use small, mixed gender groups more frequently, monitor and remediate problems, demonstrate a commitment to mixed gender work groups, and teach directly about the restrictions of sex stereotyping and different gender communication patterns.

(In McCormick, 1994, p. 65)

Scott and others believe that teachers must play a pivotal role in cooperative learning classrooms to ensure its effectiveness. If, as Lockheed and Klein (1985) suggest, "teachers take a primary role in the promotion of positive cross-gender interactions, they can present alternative sex stereotyping models to their students. Students' stereotypes about substantial differences between genders could be reduced by interacting within cross gender groupings" (p.193). Stahl (1992) tells us that many teachers consider their primary function to be quite different. He describes these teachers as taking their place at the front of the class and directly controlling the actions of their

students. He explains that most teachers are like "actors who like to hold the centre of the stage while fewer teachers behave like stage directors who are mainly active behind the scenes" (p.23).

ACTION:

Our assumption was that our classrooms did not provide a safe environment for young women to speak or utilize their preferred learning style of discussion. During my original and subsequent classroom visits I observed that this was true. Even though we had made significant improvements through writing and in individual teacher-student relationships, we still had not significantly changed the learning environment of those classrooms. The teachers in the project recognized the benefits of dialoguing with their students and sharing thoughts and ideas but were hesitant at first to expand this concept to a cooperative classroom situation. They in fact raised many concerns when I suggested we try cooperative learning as an alternative teaching method. Some questioned the suitability of cooperative learning at the high school level, others expressed concern that it was not their style of teaching, but the biggest concern to all of the teachers was that it would take too much time. They all believed it would not be possible to cover the content heavy curricula of math and science and use cooperative learning at the same time: "I can't possibly cover this curriculum and provide time for students to talk about it or find the answers on their own". Even though the teachers in the project preferred the traditional role of teacher, where they were in direct control of the classroom and the lesson, they did agree to attend a two day conference on cooperative learning.

One of the most interesting insights we had at the conference came from a group "ice breaker" activity. The cooperative learning facilitator had us write on a piece of paper the animal that best described our school. We were then told to share the names of our animals with the rest of the group and talk about our choices. The animals that we had chosen included: "white elephant because it has little value", "three-toed sloth because it is slow moving", "ostrich because it buries its head in the sand", "dinosaur because it's extinct", and "chameleon because it changes colour depending on the environment". This activity demonstrated to the teachers two things: one, that we had similar reasons for our involvement in the project and two, that this was the first time that we had spoken openly about our true feelings about the school. Although the teachers still had many concerns about implementing cooperative learning, their personal experience of having a safe supportive group where you can say what you think without fear motivated them to give it a try.

In the beginning, the issue of control was the greatest mental barrier the teachers had to overcome to implement cooperative learning in their classes. Although the teachers saw the potential benefits of cooperative learning they also saw many obstacles. Many of these obstacles focused on their reluctance to give up control. Stahl (1992) explains one type of control as "pride of place" (p.23). He argues that many teachers find it "difficult to lose what can be called the pride of place" (p.23). Stahl (1992) cites research that demonstrated that "even teachers who utilized group activities had a need to take a place at the front of the room to instruct students formally that they could begin work and generally reassumed this position to officially end the class"

(p.23). One teacher, who recently expressed interest in joining the pilot project has a great deal of difficulty giving up her place. She expressed it this way: "I know it is silly, but I have a lot of difficulty with group work because the students are not all facing me. I need to see their eyes on me to know that they are paying attention". Even though we discussed the possibility that having students look at you was not a guarantee they were listening or learning, group work was still an extremely uncomfortable concept for her. This was coupled with a strong need on her part to make sure the students were learning. She assumed a great deal of responsibility for her students' learning. She stated that having the students face her ensured she was in control of the students' learning and that would ensure their success.

Controlling how students actually learn is something teachers do every day. Hall (1990) in Stahl (1992) explains that "one of the basic characteristics of modern western culture is its linearity. This linearity is often felt by teachers to be the natural way of teaching. One of the reasons teachers advocate the linear, systematic approach to teaching is their belief that most people think in an orderly process" (p.25). This belief was an issue for the teachers in the project as many of them were concrete sequential learners and they believed that math was best taught in a logical, systematic fashion.

This linearity was demonstrated not only by their need to control the learning process but in their classroom routines as well. Many of the teachers in the project had a very structured routine. When I first visited their classes, I was struck at how the organization was almost identical. The teacher stood at the front of the room beside the overhead projector or blackboard giving notes on the topic of the day.

This was usually followed by the assigning of questions or review of questions from the previous day. These questions were answered on the board or at the projector by the teacher directly or by the teacher asking for volunteer answers. After a classroom visit, I would schedule a time with the teacher to discuss what I had observed and make some suggestions on strategies that they might try. Below is an example of a typical conversation that took place between the teachers and myself concerning cooperative learning.

CHERYL:

"I noticed you reviewed the ten homework questions on the overhead this morning. This might be a time where you could try some group work. How about dividing the students into small groups and assigning one question to each group. Give them a few minutes to review the question together and then have them give their group answer to the class".

DEIDRE:

"Won't this take a lot longer than if I do it"?

CHERYL:

"Probably at first, but I think things will speed up once the students get used to it".

DEIDRE:

"How will I know if they have done their homework or have all the right answers"?

CHERYL:

"You could walk around the room while they are discussing their answers and see what problems they are having".

DEIDRE:

"Maybe I'll try it in the geometry section in a few weeks. I seem to have more time then".

CHERYL:

"I'll come back after you've had a chance to try it for awhile if you like. If you have any problems before then or you want to talk about it some more let me know".

Initially, many of the teachers had a lot of difficulty with breaking the routine of their classes to implement group work. They raised concerns that organizing the classes into groups would take away valuable teaching time. The issue of time would become one of the recurring themes in the project as well as an indicator of how teachers interpret the role of teaching. I discussed with them that because they were covering the material in an orderly efficient manner in no way guaranteed that the students were actually learning the material; it only guaranteed that the students were on a certain page in the text. Although the teachers agreed that this was true, they also expressed that they felt a certain sense of security in covering the material especially if there was a final exam attached to the end of the semester. It was as if they had fulfilled their responsibility as a teacher by covering the material and the student would demonstrate the

effectiveness of their teaching by doing well on the final exam. This was our first real glimpse into the emphasis we place on organizing our classes around the concept of teaching rather than learning.

Controlling student behaviour in groups was another particularly difficult issue for the teachers. They were accustomed to orderly, quiet classrooms and some teachers were clearly uncomfortable with the noise that goes along with group work. Teachers dealt with this issue in different ways. Some teachers started slowly with students initially working in pairs and then moving to groups of three and four. One teacher instituted the 90% rule. She allowed students to talk about things that were not math related as long as it did not take up more than 10% of the class time. Some teachers simply got used to it as did the students. After the initial novelty of doing group work in class wore off, more and more talk time was spent on the material they were studying.

We often have visitors from other schools from this city, province, country and even abroad. One day we had a principal from another city visit our school. She had also been a math teacher and was quite interested in our project. I took her to a classroom to visit some students who happened to be working in groups. The noise level in the room was quite high. You could sense from her expression and body language that she was uncomfortable with what she was seeing and preceded to walk around the room to check it out more closely. After the class was over and we walked down the hallway, she confessed that when she first entered the room she thought that the students were simply wasting time but much to her surprise she found that they were all talking about math. She remarked that students at her school never

get this excited about math.

Another problem that caused concern at the start of the project was how to form groups. There were many questions and discussions about group size, mixing of groups by gender and race and what to do about problem students. At the beginning of the project I spent a great deal of time with individual teachers in their classrooms attempting to help them solve these types of problems. In most cases it was simply a matter of experimenting with different variations of student groups until the right combination of personalities and size was found.

Some of the teachers decided to form two different types of groups in their classroom. They labelled them base groups and activity groups. Base groups function as a support group in the classroom. If a student misses class they can go to a member of their base group for missed assignments or help with work that was covered in class. Base groups are also used during class time to help study for tests and for other evaluative purposes. The activity groups function mainly as work groups. Teachers use these groups to introduce new concepts to students, brainstorm ideas, solve problems, and other activity based work.

One of the most successful activities that we attempted during the project was the introduction of white boards in our group work. During my initial classroom visits I had observed that the teachers often requested students to put their homework questions on the board. This request was met with a great deal of resistance, especially from the girls. Students were reluctant to participate, because they were afraid their mistakes would be subject to public ridicule. To solve this problem we purchased several 2'X 3' white boards for the students to use

in their groups. The students would discuss their homework questions in the group and then place their group response on the board. These boards would then be displayed around the room and either the teacher would present the answers or the group of students would explain why they had solved the problem in a particular way. This approach proved to be extremely popular with the students. Not only were they quite willing to display their answers but in nearly all cases students took time to personalize their white boards by writing all the names of the group members on the board or occasionally drawing pictures of themselves. Students use them when they are brainstorming, sharing ideas or presenting new concepts. Five years later the white boards continue to be an integral part of our class activities. Below are a few excerpts on the value of the white boards.

DEIDRE'S RESPONSE:

"The addition of white boards to the classroom made a real difference. Girls prefer these over the chalk boards. They often ask why they don't have these in other classrooms".

FEMALE STUDENT RESPONSE:

"The white boards are great. I hated going to the front of the room to put my homework on the board. I was always afraid someone would laugh at me. Besides I'm really short and I think people will think I look foolish up there. In our groups we can all talk about what we think and put our answer up and nobody makes fun of it".

The concept of group evaluation was also an important area of

concern for teachers. They questioned how you judge individual participation and contribution in group activities and was it fair to assign the same marks to all of the students. Again each teacher has handled this in a different way. One teacher assigns a certain percentage of the term work to group activities and each student in the group receives the same mark. One teacher does a lot of group work but all evaluation is done individually and one teacher does group work with each student receiving an individual mark for their group participation. Another teacher occasionally gives each student in the group a different coloured pen so he can evaluate who is contributing to the group process by simply visiting each group. Whatever method is used each teacher has found their own comfort level with the group process and every student understands the evaluation process within that class.

By the end of the five year period the teachers agreed that having students work together in groups has many educational advantages especially for young women and other groups of students who have traditionally been shut out of the conversations in our classes. Group work allows for the safe exchange of ideas and discussion. Students actively talk out problems and solutions, make decisions and work through to conclusions. Following are some comments from one of the teachers and both male and female students about group work. It is interesting to note the shift in perceptions of group work by the young men.

LAURA'S RESPONSE:

"Activity groups were used to develop and review unit concepts, share work and function as an assessment. Group work built a caring

atmosphere, a sense of responsibility for each other and provided someone to talk to when problems arose and I was not available such as at night or early morning”.

FEMALE STUDENT RESPONSE:

“When my term mark was given to me I thought to myself that I know that I’m capable of doing better. I think that I’m capable of getting higher marks. Usually I forgot my math pretty soon after I learned it but that doesn’t seem to happen any more. Anyhow, I find that working in groups and going over answers is a good idea. There were times that I didn’t know how to do a particular question and I had the people in my group help me. You also get the opportunity to explain to each other if someone doesn’t quite know how to do a question. This is the first time I have ever heard of a math class that works in groups. Usually the teacher goes up and down the rows asking for the answers. What other things will be taught in groups? I like this better. You don’t have to be so afraid of having wrong answers”.

FEMALE STUDENT RESPONSE:

“I thought group work was fun and helpful. I enjoyed working with my friends and meeting new people. In group work, if you don’t understand something someone else in the group will explain it to you in their own words which might be easier to understand than the teacher. Also, if you need help someone is there immediately. A teacher has so many other students in the class to help they can’t always be there when you need them. I think this is an excellent way to learn in a positive surrounding”.

MALE STUDENT RESPONSE:

"At first I did not think that groups were a good idea, then after awhile I realized that it is helping me learn. When I don't know something I can ask someone in my group. In other classes you feel segregated, but in this class you feel together and you can communicate with others".

MALE STUDENT RESPONSE:

"I think that the groups are very helpful for student learning. Although I thought it was a stupid idea in the beginning I was proved wrong. My group partners helped me answer questions that were hard for me to understand. Your group partners don't laugh when you make mistakes like other people do in other classrooms. When you do something right everyone in the group is happy for you".

This sharing of ideas in a safe environment promotes a community of respect within the classroom. This was one of the common themes amongst all of the classes in the project. The community of respect promotes a better learning environment for the students as they become more engaged in the learning process and accept more responsibility for their own learning. Cooperative learning has not been a panacea for including young women in our classes nor do all girls learn best cooperatively. It has, however, been a useful tool in providing a safe supportive atmosphere in the classroom where all students can share their thoughts, ideas and experiences.

In summary I would say that the teachers in the pilot project use cooperative learning to varying degrees and with different successes.

One of our teachers prefers the more traditional, teacher at the front, style of teaching while most of the teachers fluctuate between cooperative learning and other types of activities. The teacher who was most uncomfortable with giving up control of her class now uses cooperative learning quite extensively.

CHAPTER SIX

ROLE MODELS

I know that I can go through this course and get
good marks because I can do anything I want to do!
I think you know that's true. Do you or am I wrong?
(Student response)

ASSUMPTION:

Although many young women have been counselled on the importance of math and science to their future they seem to exhibit a we can, I can't attitude. It is critical to do more than tell girls they can have a future in math or science. We must provide opportunities for the young women who dream of a career in math or science to develop connections with potential mentors and role models.

LITERATURE REVIEW:

Many researchers, including Rosser (1990) have revealed that a critical barrier to women in science is sex-role stereotyping. She cites evidence that tell us that "men are are more likely to demonstrate traits associated with scientists. Students often view a scientist as a white male, making it difficult for young women to see themselves in that role" (p.39). This perception is reinforced by the reality young women see and experience around themselves everyday. One example occurs in "engineering and physics faculties where female enrolments of less than 5% still exist" (p.1) (Rosser,1990).

Rosser (1992) also cites evidence that tells us that "the importance of role models should not be discounted, since a large proportion of women and minorities in science or engineering today have

a parent or close relative who works in a technical field" (p.39). She also found that the most important person in influencing a young women to study science is a parent. However, students who do not have the family role models often look to a teacher. She cites evidence that also tells us that the importance of mentors cannot be overlooked. Even though these may not be life long relationships they can form the basis of support for many young women's choice to pursue a career in science.

Brown (1993) found that role models seemed to have a significant impact on students' attitudes towards science and engineering and their subject choices. In her study she found that "female role models can help to break down stereotyped attitudes as well as influence students' subject choices" (p.501). She goes on to indicate that role models also "appear to affirm subject choices that students have already made" (p.501). Although Brown (1993) argues that role models seem to have a positive affect on students she states that "parents remain the greatest influence on a student's subject choice" (p.501). Shadia (1993) in her study on involving female instructors in chemistry classes found that "female instructors encourage students to perceive chemistry as easy to understand and improved performance of the young women enrolled in those classes" (p.173).

Even though the importance of role models is well documented, it is often difficult to provide them to students. There are simply not enough women role models in the sciences to provide such opportunities to female students. Where women role models do exist they are often overburdened by request to fill that role. Therefore, role modeling places the responsibility of encouraging young women on too few numbers of women in any particular field. Emms and Kirkup (1993) advocate:

shifting the emphasis from the behaviour of girls and women to examining the institutional responsibility for change, placing more responsibility on the men who dominate the field. They go on to state that role modelling provides an alibi for male inaction. As long as male academics can say if we only had more women on staff, we would have more female students, they can place the onus for change on women

(p.320).

Emms and Kirkup tell us that mentoring is different from role modelling. They cite evidence that argues "mentors must do something for a small number of students with whom they develop a personal relationship rather than be a model for people they have never met" (p.320). Collins (1983) in Emms and Kirkup (1993) describes mentoring as:

a process in which a person (mentor) is responsible for overseeing the career and development of another person (protege) outside the normal teacher/student relationship.

(p. 320)

Emms and Kirkup (1990) tell us that there have been many conflicting views on the ethics of mentoring. They provide evidence that indicates that "if mentoring teaches women how to succeed within an organization, how can new values and models of behaviour occur" (p.323)? Another issue that they raise is, "are we simply instituting an old person's system that encourages favouritism, elitism and unequal opportunities" (p.324)? They go on to tell us that given the debate and controversy about mentoring it still is one of the most important factors affecting the student's success.

ACTION:

Although the math department has women teachers and a woman

department head, there are still few female role models at our school. The science department currently has only one female teacher. Initially, I had avoided encouraging her to be a part of the pilot project because I felt there would be too much pressure placed on her as the only woman in a male dominated department. However, because of her interest, she has become a part of the project and joined in on a number of our activities.

To further address the importance of role models and/or mentors in young women's lives, we developed a program at our school entitled Scientists in the School during the second year of the project. The purpose of this program was to introduce more of our young women to the possibility of a career in a math, science or technology related field. Our objective was to provide positive female role models for our students by inviting women scientists from our community to take part in the teaching of part of our curriculum. They were asked to relate what the students were studying to real life situations and explain what being a scientist meant to them on a personal level. We felt it was important to portray women scientists as real people who have rich rewarding lives outside the lab as well as a career. We also wanted the students to be able to see the direct connection between what they were currently studying in class and its application to the world of math or science.

I contacted several women scientists in the community and provided their names to the teachers. The teachers, the scientists and I then met and discussed possible areas of content that could be either taught by the visiting scientist or team taught with a particular teacher. At our initial meetings we discussed the pilot project's purpose and goals

and the importance of providing connections for our students while honouring their different learning styles. A great deal of time was spent by both the scientist and the teacher in planning the lessons. Some of the women scientists were working in places that supported encouraging young women and so this was assigned as part of their work load. Many however, gave up time from their own research projects and labs. We felt it was important to recognize the importance of this work and also acknowledge that as women mentors they were often asked to volunteer their time so I obtained funding to provide monetary compensation for their involvement in the program.

To illustrate the way in which these women made connections with our students I will describe one sample lesson. The example involves a human geneticist and our grade 12 biology class. The class was studying genetics as part of their regular program and the scientist was asked to deal with the section on DNA and genetic coding. The scientist and the teacher met on three occasions prior to her visit and planned what areas the teacher would cover to prepare the class for her visit. On the first day she started by introducing herself and giving the students some personal information about her background, her life and the type of work she does as a genetic counsellor. She ended the class with a brief introduction to the types of things they would be studying in class over the next few days.

The second day she arrived with several test tubes containing samples of her own blood that she had prepared in her lab for the class experiments. Students were given one of these test tubes and asked to add a chemical compound. When they did, they were amazed to see her human DNA strands appear in the test tube. She explained that this is

where the markings are found that give the vital information about each individual. She then gave the theory on DNA and genetic coding and students were given assignments on the topic to discuss the following day.

The final class focussed on ethical issues in DNA testing. Students were put in groups and given a hypothetical ethical issue. For example, should parents be able to get genetic information about their unborn baby? The students discussed these issues in their groups and reported their opinions back to the class for further discussion as a whole group. The class ended with the scientist giving her opinions as a genetic counsellor and how these decisions affect peoples' lives and her own in a very significant way.

The students have been quite enthusiastic about this program as it provides opportunities for them not only to meet women scientists but to work side by side with them on a particular section they are studying in class. It also allows them to experience how the theory they are studying in class actually applies to a person's life and their careers. Below are some examples from students' writing on their participation in the Scientists in the Schools program.

"The class on DNA testing was cool! It was really neat when those strands appeared in my test tube, especially when I knew whose they were".

"I think being a human geneticist is very important work. I never realized there were so many ethical issues involved in science. I'm not sure I would want to have someone's life in my hands".

“Class today was really fun! Do you ever use DNA testing to catch criminals? If so how do you do it”?

“I never knew being a scientist could be so interesting. I think I would like to do this. Can we go visit her lab or could I maybe spend a day with her”?

“On Thursday we had a class with a human geneticist. She talked about DNA testing and ethical issues. I really like the way you get different people from different careers to come and tell us something about their profession. It doesn't just tell us something about what we are studying, but it opens a door and lets you see what there really is out there. What to do and how to go about it. These classes also make me more aware of how important math and science are”.

Even though the Scientists in the Schools program was extremely successful with the students it does have its limitations and drawbacks. Much of group discussion by the project teachers has focused on the amount of preparation time it took by the scientist and the teacher to present these lessons to the students. This time was needed to ensure that the people coming to the class understood the philosophy of the program so they could structure their presentations to make connections with the students. This was often a new concept for the scientists because their educational experiences had been very traditional.

Although each teacher acknowledged that the students enjoyed these classes and did gain valuable insights into these peoples' lives and work, they also questioned the effectiveness of having these experiences

only once or twice a semester. They had already learned that the connection between the instructor and the student seems to be the most critical factor in a student's life and the teachers argued that you could not make that connection in 2-3 days. As one teacher put it, "I think you would have to have these people on a regular basis before you could really determine the impact they are having on the students' lives". As the coordinator, my observation is that the Scientists in the Schools program has touched the lives of some of our students but has also underscored the debate concerning role models vs mentors. For us it emphasizes the importance of having both visiting women scientists as role models and math and science teachers on staff as mentors who are aware of gender issues in education and can provide inclusive instruction, inspiration and support to their students on a daily basis.

For the young women in our classes who expressed an interest in pursuing a math, science or technology related career, we attempted to provide some further supports and opportunities. We did this by sponsoring several young women to various conferences, camps, and summer institute programs being held all over the country. This provided the opportunity for these students to explore in greater depth whether a career in a math or science field was really of interest to them. An excerpt from a letter written by one of the students after returning from her month long participation in the Shad Valley Program will illustrate the impact these opportunities had on our students.

"The four weeks that I have spent in the Shad Valley Program at Acadia University ended up being the best four weeks of my life. This program gave me more than an opportunity to go to the east coast. It

provided me with a number of incredible, unique experiences.

The Shad Valley Program provided the opportunity to discover many new interests that I will be able to pursue in the future. These interests showed me that there is a lot out there in the world for me. The academic lectures and seminars gave us the time needed to do this discovering. The staff were extraordinary. Not only did they do a wonderful job teaching but they also cared! The guest scientists allowed me to see in reality how what was being taught is used in real life. Throughout the program I became familiar with myself as well as other people's goals, future interests and plans. This helped me to realize that I have the ability to go after my own dreams. The only limitations are those that I set myself. This gave me an incredible sense of ambition and hope.

The friendships that I made were the most valuable part of the experience. The people were incredible and it was wonderful to meet so many people who both share my dream and have their own unique talents and strengths. As we came to understand our differences we were able to benefit from them and became even stronger. I don't think any of us expected such close bonds to develop so quickly but we all realized it when it came time to say goodbye. I have never seen so many people emotionally touched before. One of the hardest things I had to do was get on the plane to go back home. I guess someone explained the feeling perfectly when she said, "We may be going back home but we can never go back the same".

Although we attempted to provide opportunities for our students to see and work with female role models we are not sure what lasting affect this has on our students. At this point, I would say it is important

for young women to see women who are scientists and mathematicians but the more lasting affect comes from supportive mentors who may be either men or women.

CHAPTER SEVEN

COMPUTERS AND TECHNOLOGY

Your method of trying to make us see and understand how a computer works and what goes on inside is a very smart way of teaching. When I come into your class I put myself on "logic mode" and I try to think that way so I can be as much as I can on the same wavelength as you and the computer. What I do find annoying, you could say, is that the computer is too logical. It is so sensitive to order and precision. One tiny step is so important to it. It's hard for me because I'm human, and not so logical. It gets me aggravated. I'm just a bit scared and anxious about the future in this course.

(Student Response)

ASSUMPTION:

A computer culture exists that is decidedly masculine and intimidating for most young women.

LITERATURE REVIEW:

Despite a general increase in awareness of equity issues, there is still considerable inequities in access to the math, science and technology streams (Sanders, 1990). Ryba and Anderson (1990) warn us that there is "a significant consequence of this inequity is that female students may be educationally disadvantaged through a lack of opportunity to access and use technological tools for collecting, analyzing, displaying and learning information as well as solving complex problems and developing reflective thinking skills" (p.1). Female students have fewer career options because of their lack of technology and computer skills (Campbell & Perry, 1989). Schools have a responsibility to ensure that our students will have opportunities to

see where math, science and technology can be integrated within their learning (Gaskell & McLaren, 1987).

Romaniuk (1986) as cited in Gaskell & McLaren (1987) explains that "computers in particular are becoming more commonplace in schools, and there is an expectation that some sort of competence with computers is a valuable and even necessary component of the contemporary school experience" (p.117). Studies by Collis (1984) as well as other researchers document that significantly more boys than girls take optional computer courses and participate in computer based activities. Also, boys tend to dominate the limited computer resources at schools and have more frequent access to home computers than girls do. Further studies have shown that "families with only girls are less likely to own computers than families with boys" (Stephenson, 1995, np.).

A survey of 113 first year University of Winnipeg students indicated that they feel women are under represented in the area of computers and technology because "girls aren't encouraged to go into scientific fields, they are discouraged from taking math and science courses and computing is thought of as a man's field" (Stephenson, 1995,np.). She also tells us there is also a lack of female role models. Stephenson found that in 1993-94 Manitoba High Schools male computer science teachers outnumbered female instructors by about 6 to 1.

Kantrowitz (1994) attributes gender inequities in computer use to a male-bonding ritual. She provides evidence that suggest "men tend to be seduced by the technology itself: they tend to get into the faster race-car syndrome bragging about the size of their disks or the speed of their microprocessors. While women are much more practical, much more

interested in the machine's ability. I don't really care about its innards. I just want it to do the job" (p.50).

Males consistently report more positive attitudes towards computer than do females (Collis, 1984). Research indicates that because females report that they have lower abilities in this area they tend to drop out at a significantly higher rate than males especially during the first three months of class (Forder, 1990). The tendency to drop out of computer classes exists even when the women students had high academic abilities (Nevitte, Gibbons & Coddling, 1988).

Kantrowitz (1994) cites evidence that tells us girls' attitudes towards computers are that "computers are something my dad or brother uses" (p.51). She tells us that young girls do not see computer science relating to their world. Kantrowitz argues that the young girls who do attempt to get involved are soon given a message that they are not wanted. She goes on to tell us "that girls are generally interested in computers until about grade five. At that point, boys' use rises significantly and girls' use drops" (p.51). Kantrowitz believes "this is the time that sex-role stereotyping really begins to kick in" (p.51).

Kantrowitz also cites videogames as one of the reasons for gender inequities. For the most part videogames have been designed to be used by boys. This is because fewer girls are interested in games whose major theme is guns and violence. Kantrowitz indicates that this is likely because the majority of videogame designers are men. Kantrowitz (1994) also tells us "it is no coincidence they call the equipment game boy. There have been some inroads into the computer game market for girls with Sega introducing games based on book characters and exploring the trend that girls tend to prefer nonlinear games, where there is more

than one way to proceed through the game" (p.51).

Cuban (1994) found that students use computers for a variety of reasons. The results of his study indicate that "computers are seldom used in subject areas, and where they were used, the purpose was to teach about computers" (p.51). He also found "disparity in computer use due to equity issues. Students from high income families had far more access to computers and that black students use computers less than white students and students whose native language is not English have the least access of all" (p.51). He also argues that although students do benefit educationally from the use of computers he is concerned that ultimately their extensive use will interfere with the teacher-student relationship.

Some schools are trying a number of approaches to include young women in computer use. Some of these initiatives include mentorship programs where girls stay after school or come in on Saturdays or holidays to work with scientists. Other schools have attempted to integrate technology across the curriculum, while still others are implementing projects that relate computer use to specific content areas of a course like producing a school newspaper.

ACTION:

We had assumed that there was a decidedly masculine culture associated with computers. Since this assumption seemed to be supported by the literature and some of the interview responses from the girls at our school, we decided to integrate computers into our regular classes. Our theory was if we could give more young women an opportunity to use computers in a more supportive classroom environment and see their

applications then possibly more young women would become interested in computers and computer science. We did however, share many of the same concerns that Cuban (1994) has discussed. We made a decision to support computer use in our classes with the understanding that they would be used as a tool in our classrooms and not a replacement for teaching. To accomplish this, we carried out several initiatives. The first initiative was the development of an integrated Math/English computer lab.

In addition to coordinating the project I was also teaching English half time. The math department head and I wrote a proposal to secure funding for a new Macintosh computer lab at our school that would be dedicated to integrating computers into the teaching of Math and English. Part of the rationale in our proposal was that young women at our school rarely used computers. We hoped that having computers available in a regular classroom setting especially in a subject area like English and with teachers who are sensitive to gender issues would provide a safe environment for girls to familiarize themselves with the computers and their applications.

The students who took English on computers used them for a variety of purposes. This included: taking their regular class notes directly on the computers, writing and editing of their work, producing written work in various forms such as newspaper columns and feature articles, producing handbooks and multi media presentations. Although hesitant at first, the girls soon learned how to use the programs and began to experiment with the different types of software in the lab. Below is an excerpt from one of the students.

"When I first walked in the room and saw the computers I was scared. I hate anything that has to do with machines and I was convinced that I would break something. Well, its almost the end of the semester and everything is still in one piece. I must say I have really enjoyed learning to use the computer. I am really proud of what I have accomplished. For my final English project I produced a teachers' manual for one of the grade ten textbooks and printed it on the colour laser printer. Some of the grade ten teachers even want to buy a copy from me. Who would have believed it"!

In addition to teaching English in the Mac. Lab. the Math department head also piloted the grade 12 math course on computers. We ordered a special software program that had the entire course laid out in different units. At the beginning of the semester the students spent quite a bit of time working through the course directly on the computers with the teacher's assistance and direction. By the end of the semester a decision was made to have the class in the computer lab only half of the time and the other half was to be spent with regular classroom instruction. Although the students were able to work through the math problems on the computer both the students and the teacher felt they benefited more from direct interaction with the teacher. The students also indicated that they missed the group work. Below are some excerpts from the students' writing on their experiences with computers in math class.

FEMALE STUDENT RESPONSE:

"Hi there! I personally enjoy working on the computers. The

computer basically guides me through the process of how to approach problems, step by step. I usually could understand the computer, yet I miss having you teach because you make us use our brains and it's easier to ask you questions. I like the combination of both computer work and you teaching the class".

MALE STUDENT RESPONSE:

"When I first applied to take this course I knew that computers would be a part of my learning and I came in with an open mind. For the first few days we worked on the computers only, and for a second I was worried because I thought this was the only way I was going to learn. Luckily, my most dreaded thoughts were dashed and I found that you would be teaching us and then we would apply what we learned on the computer. What I'm trying to say is that computers are great but they can never replace the teacher. I have found that out because there is less interaction with computers and it becomes a master-slave situation".

Another math teacher uses computers in her classroom for enrichment and remedial work. She has developed several software programs that deal with the content of the course. She has made these programs more personal by including the names of the students in the class in the word problems and providing examples of situations that the students can relate to in a direct way. She is also piloting programs for the Department of Education and Training.

We also introduced computers into the science class. These computers were used in a variety of ways. Initially, the students used them to work through different software applications that were used to

supplement the regular program. These could be in a tutorial form or as added enrichment. One of the most interesting applications was a program entitled MacDiet. The students kept track of their diet for a period of 3-5 days and entered the data into the computer program. The program then analyzed their diet and broke it down into a graph indicating what nutrients, calories etc., the students were getting and gave suggestions of the types of foods the students could eat to supplement their diet. It also asked the students to enter personal information about their body size and activity patterns. The program then produced a weight profile that indicated what their weight would be after a certain period of time if they continued this type of diet and exercise routine. The students were quite interested in the program and it helped to relate what they were learning about the body systems in their biology class to their own lives. We also gave the students writing assignments based on the results of their MacDiet program. These assignments focussed the students' thinking on the connections between their diet and their lifestyles. The school nurse also came in and spoke about diet and nutrition and reviewed their personal data and writing assignments. This resulted in us identifying some girls who either had eating disorders or were at a high risk.

The students have also been exposed to the internet in their science classes. The students choose topics that they can explore on the net and produce individual assignments based on the information that they have found. We also use the internet to connect with scientists and other specialists around the world. Finally, we have partnered with the University of Manitoba and are one of the few schools in the country to use a software package called See U See Me which enables students to

see the people that they are hooked up with over the internet thus providing an opportunity to relate to these people on a more personal level.

Computers have become an essential tool in our classrooms for the acquisition, analysis, presentation and communication of knowledge and data. Computers have allowed our students to become more active participants in the research process and their own learning. The computer also allows the teacher more flexibility in presentation, management and delivery of instruction. These capabilities can enhance learning but I must emphasize that we use computers to enhance learning not replace teacher-student interactions and instructional practices.

We have seen a dramatic increase in the number of girls who access computers in our school. It is not unusual to walk into the Mac Lab and see that girls make up the majority of the students using the computers to work on their assignments. We also have many more girls enrolled in our computer awareness classes. I can't predict whether this will translate into an increased number of girls taking computer science. There are still many external factors that continue to influence the choices of our young women. These include: types of software available, the control of the internet by men and the machismo mystique associated with computers.

CHAPTER EIGHT

ASSESSMENT AND OUTCOMES

Educators who tackle restructuring are caught in a time warp between the old and the new. On one hand, teachers are being asked to teach their students to think - to forsake superficial coverage of content for depth and understanding. On the other hand, they are still judged publicly and privately by standardized tests that emphasize isolated facts, rote learning and content coverage.

(In Hewitt, 1994 p.176)

ASSUMPTION:

We need to ensure that our assessment methods are connected to our teaching strategies and that they reflect the diverse learning experiences and preferences of our students.

LITERATURE REVIEW:

It has been said many times that assessment is the tail that wags the curriculum dog. One teacher illustrates this view when she states:

I realized early in my career that students experienced optimal learning when I allowed my assessment methodology to shape my teaching.

(In DeFina, 1991, p.8)

Some would argue that just as there needs to be connectedness in the teaching process so should there be a connection between curriculum, teaching and assessment. Wasley (1994) tells us that in schools this connection has been ignored. She states that "traditionally, curriculum and/or assessment has reigned supreme and teachers have worked in isolated departments worrying about standardized tests" (p.187). As a result, she argues that "teachers have thought mostly about how to cover curriculum and prepare students for a common exam at the end" (p.187).

Goodlad (1984) tells us this method ends up with teachers covering material but students not learning it. Cizek (1995) cites research which indicates that covering material too quickly results in subjects being watered down and controversial issues being deleted from the curriculum. He argues that teachers are so busy covering material they seldom take the time to demonstrate to students how to apply their knowledge. Cizek (1995) tells us his theories about course coverage are supported by the statistics of the bell curve. He argues that very few students learn a topic well.

Earl & Cousins (1995) tell us that if we intend to change our expectations for students we will also need to change our assessment procedures. They argue that "an over-reliance on tests and exams limit teachers' ability to adequately assess the extent over which specific outcomes may have been achieved or how learning has taken place" (p.38). Earl & Cousins (1995) cite evidence that "standardized achievement tests and examinations inquire into answers as end products"(p.39). Standardized tests or tests of standards can also perpetuate gender and/or cultural bias in our schools.

Murphy (1993) tells us that "assessment in whatever form has always been a critical element of our educational system" (p.277). She argues that arbitrary decisions are made about what is implemented in assessment procedures that ultimately affect student performance. Harding (1989) argues that just as the content of curriculum is masculine so are the forms of assessment. She states that the assessments used in math and science reflect what men consider to be knowledge and worth knowing. There is considerable evidence that multiple-choice questions give an advantage to males. Murphy (1993)

gives two explanations for this. "Firstly, that females have a broader view of relevance than males and are more likely to see ambiguity in the responses and secondly that females more than males opt for the choice I don't know or none of the above" (p.281). Murphy states "there has been an assumption that question cues are understood in the same way by all students, the task perceived by students matches the assessor's perception and failure on a task reflects a lack of knowledge. These assumptions are not always valid since students do not necessarily have similar perspectives, experiences and often have different learning styles" (p.281).

Rennie and Parker (1991) tell us that assessment procedures are not valid if they don't capture what the students really know. Logan & Bailey (1989) in Hegarty-Hazel, Logan and Gallagher (1993) state that "research on science assessment found that students of non-English speaking backgrounds have trouble with some of the non-technical words in science. They also discovered that if students translate questions into their own language that there is likely to be language and cultural interference" (p.774). They also found that "women performed significantly better on questions involving context or qualitative answers" (p.774). In the past, quantitative questions have been used extensively for assessment in the areas of math and science. Educators have failed to recognize that students might be able to perform well on some types of assessments and yet not be able to transfer that knowledge to a different type of assessment procedure (Hewitt, 1994).

The vast majority of research currently being conducted in the area of assessment points to the necessity of implementing a variety of measures. The assessments should take place throughout the duration of

the course so the student is able to apply what they have learned from the assessment procedures. Currently, many teachers regard assessment as a process which occurs at the end of a unit of study or period of time.

Much of the current research on assessment has been focused on performance based and authentic assessment. Performance assessment allows students to demonstrate their abilities through a variety of projects. Hewitt (1994) cites research that states:

experts often fail on formal measures of their calculating or reasoning capacities but can be shown to demonstrate precisely those same skills in the course of their ordinary work. In those cases, it is not the person who has failed but rather the measurement instrument which is purported to document the person's level of competence.
(In Hewitt, 1994, p.187)

She goes on to tell us the importance of ensuring that authentic assessment occurs within a context that makes sense to the student.

Traditionally, many teachers have felt uncomfortable about changing assessment procedures because of a lack of training in this area. Wasley (1994) reviews research dealing with assessment and notes that teachers need to be better diagnosticians of individual student's learning. She argues that new assessment measures need new teacher skills and that teachers need a better understanding of various forms of assessment. She states that "in classrooms where students are expected to be engaged in mathematical or scientific thinking and in constructing and reorganizing their own knowledge requires adaptive teaching informed by observing and listening to students at work" (p.193). She tells us that more practical, hands on assessments are needed with the new math and science curriculum. She also argues that teachers must begin to

integrate the use of technology within their assessments.

The National Council of Teachers of Mathematics (1995) states that:

Students differ in their perceptions and thinking styles. An assessment method that stresses only one kind of task or mode of response does not give an accurate indication of performance, nor does it allow students to show their individual capabilities. A timed multiple-choice test that rewards the speedy recognition of a correct option can hamper the more thoughtful, reflective student.
(p.202)

ACTION:

The pilot project team has struggled with the issue of assessment since it first began five years ago. At the start of the project, assessment was identified as a major barrier to change. Teachers were constantly concerned that initiating innovative ideas would take away valuable teaching time that was needed to cover the material for the final exam. Other struggles centred on issues of whether writing assignments should be graded and marked for grammar errors, how to assess group work, and how large a percentage should be assigned for alternative projects and assignments. Very little of our early discussions focussed on issues of fairness, equity or appropriateness of our assessment tools. Along the way, these teachers have come to understand the interrelationship of curriculum, instruction, technology and assessment. The teachers had worked in subject based departments, worried about final exams designed to cover a set curriculum. As a result, they have experienced the same process as described by Wasley (1994) "where closer to the time to deliver curriculum teachers think about pedagogy and when the actual teaching is done, they begin to think

about assessment" (p.188).

In the last year of the project, the teachers decided to focus on assessment as their priority. They have made great strides in the area of alternative assessment for our students. They attended conferences on a variety of topics ranging from portfolios and authentic assessment to outcome based education. As these teachers have begun to shift their focus from teaching to learning, the design of their assessment tools has tried to ensure that all students can demonstrate their knowledge and understanding.

Determined to discover whether their students really understand what has been taught, many of the teachers began to experiment with alternative forms of assessment. These included: self-assessment checklists and statements, worksheet quizzes and tests, collaborative works, interviews, journals and portfolios, teacher checklists and comments, concept maps, defense arguments, research papers and computer simulations, to name only a few. David has been experimenting with alternative forms of assessment using the computers. The students have been working with a computer program called Digital Chisel. This program produces electronic portfolios and assignments.

David also became quite interested in the fact that young women do not score as well on multiple choice test questions. We were able to verify this fact by doing a gender analysis of his class's exam results. In his class 100% of the boys scored higher on the multiple choice section of the exam than their overall mark and 100% of the girls scored lower than their overall exam mark. These results were also similar to the results of our math provincial exam. David has now worked out a system where students take multiple choice tests in two parts. The

first part consists of the traditional test which he marks and assigns a knowledge grade. The second part instructs the students to write an explanation justifying the answer that they chose and this is assigned an understanding grade. When I reviewed the test results with him, it was quite interesting that some young women received a mark of 3 or 4 out of 10 for the knowledge section but 9 out of 10 for their justification of their responses. It became quite obvious to both of us that these young women had based their multiple choice test answers within a different context than the teacher had written it. He is now in the process of designing a computer program to assist his students in working through sample multiple choice items. He is also reviewing all of his own test items and rethinking the fairness of some types of questions.

Another assessment issue we are just beginning to explore is how to give feedback to female students. Shakeshaft (1988) in her critique of leadership styles raised the issue that women often do not receive feedback about their job performance, especially from males, because men are afraid women will cry. I also knew from previous research that young women receive less attention from teachers and are asked lower level questions and fewer follow up questions. I began to wonder if we also give different kinds of performance information to our female students. In one of our group meetings I asked the teachers how they provided feedback to the young women in their classes. Richard admitted this was a very difficult issue for him, because he was afraid of hurting their feelings. He stated that he tended to back away from writing comments on girls' papers that might be interpreted as critical. I related an experience that I had several years earlier when I was

coaching a high school basketball team. One of my best players was not playing particularly well and dropped into my office to ask what she could do to improve. I began to critique her performance at practice that night and gave her several suggestions to try the next day. She listened attentively while munching some cookies that were sitting on my desk. When I finished talking she burst into tears exclaiming she couldn't do anything right! As we talked further, I realized that she hadn't wanted a critique of her play but reassurance. I jokingly made reference to the fact that I hadn't realized that she had wanted cookies not criticism. This became a standing joke on the team and I kept a stock of cookies in my office for the remainder of the year. When any of the players came in and picked up a cookie it was a signal to me that they wanted my support and encouragement.

The project teachers all agreed that it was difficult to find a balance between critiquing students' work and maintaining a supportive relationship. We discussed whether girls internalized feedback as personal criticism more than boys. Laura and Deidre felt it was easier for them to make comments to the girls than it was for David or Richard, and I would agree with them. I had noticed in the responses to the question and answer box that the female teachers gave more direct feedback than the men. Below are some excerpts where Laura and Richard respond to two female students who have expressed concern about their marks.

LAURA:

"I can see you are having difficulty with this section of the course. I think it would be helpful for you to review your notes every

night. This will make it easier for you to study for the tests. You are a capable young woman but you need to get back on track”.

RICHARD:

“Believe it or not I’m going to miss these written conversations. I really appreciate you sharing your feelings with me. It seems to be a quirk of nature that we enjoy the things we do well in and not those things in which we struggle. You must remember as far as this subject is concerned, your results are better than most people”.

We finished our meeting with a lengthy discussion on the importance of finding an approach to provide our female students with constructive and supportive feedback. This continues to be a difficult issue for all of the teachers.

It is ironic that as teachers we are just beginning to understand the complexity of assessment and the importance of having multiple assessment procedures that reflect the teaching and learning process of our classroom at the same time that the provincial Department of Education is mandating tests of standards. Lately, we have been having the same kinds of discussions we had five years ago, but this time the questions are “how will we cover the content to write the provincial exam and don’t they understand how unfair this will be to some students especially young women and our minority students”?

CHAPTER NINE

STUDENT AND TEACHER OUTCOMES

The big thing for me has been the difference in the young women's self image and confidence. I've seen a real difference, a willingness to lead, ask and present questions, feeling good when they get it right and defending their views even when they are not sure.
(Teacher response)

We have made significant strides during the five years we have devoted to implementing gender inclusive education at our school. These successes have not only been in the areas of student achievement and enrolment but also in the implementation of several new programs aimed at making connections with our students. Following is a brief discussion of some of the successes of the program.

ENROLMENT:

As I indicated in chapter 3 we compiled data on the numbers of young women enrolled in our math, science and computer science classes. We focused on the three areas that young women in our province are least likely to enrol in: Math 300, Physics 300 and Computer Science 305 (these courses are now designated as S4 level courses). Following you will find provincial data from 1990, our base line data from 1991 and our current enrolment figures for 1996. We currently have approximately 300 students enrolled in our school. Young men make up approximately 53% of our school population. The total number of students enrolled in 1991 were: math (198), physics (76) and computer science (10). The total number of students enrolled in 1996 in these same subjects are:

math (156), physics (66) and computer science (15). The total number of students enrolled provincially are: math (7405), physics (3565) and computer science (685).

ENROLMENT PERCENTAGES FOR MALES AND FEMALES

TABLE 8.0

	<u>MB. 1990</u>		<u>OUR SCHOOL 1991</u>		<u>OUR SCHOOL 1996</u>	
GENDER	M	F	M	F	M	F
MATH 300	52.0	48.0	55.0	45.0	49.0	51.0
COMPUTER 305	77.0	23.0	95.0	5.0	67.0	33.0
PHYSICS 300	64.0	36.0	77.0	23.0	49.0	51.0

As you can see from these figures we have seen a significant increase in enrolment for young women in all three areas of study. At first glance you might say but the boys enrolment has dropped. This is not true. The actual number of boys in these courses has remained relatively stable; the number of girls has increased.

ACHIEVEMENT:

Another piece of data that we have tracked over the last five years is achievement. Table 9.0 represents the achievement levels of our students in math 300, physics 300 and computer science 305 for the years 1991 and 1996.

MEAN SCORES IN PERCENTAGES FOR MALES AND FEMALES:

TABLE 9.0

<u>SUBJECT</u>	<u>1991</u>		<u>1996</u>	
	<u>MALE</u>	<u>FEMALE</u>	<u>MALE</u>	<u>FEMALE</u>
MATH 300	55.0	55.0	60.0	65.0
COMPUTER SCIENCE 305	61.0	79.0	59.0	76.0
PHYSICS 300	68.0	61.0	71.0	76.0

The achievement figures represent a significant increase for the girls in both math and physics and relatively no change in computer science. The boys' achievement has risen slightly in math and remained relatively stable in computer science and physics. The physics teacher has indicated that 84% of the girls scored a mark higher than 80% this semester while the math teacher has indicated that 8 out of the top 10 marks in grade 12 were awarded to girls. This year our students wrote a provincial math exam. Below are the figures for the first semester provincial exam. I have indicted the scores for both our school (53 students) and our project class (15 students).

PROVINCIAL EXAM MARKS

TABLE 10.0

	<u>SCHOOL MARKS</u>		<u>PROJECT MARKS</u>	
	M	F	M	F
RANGE:	26-98	32-92	36-98	54-84
MEDIAN:	62.5	67.0	69.0	74.5
MEAN:	60.0	64.0	69.0	74.5
PASS %AGE:	64.0	76.0	67.0	100.0

The province did not provide a gender breakdown for their province wide results. The overall results for the province were a mean of 61.4 and a pass rate of 70%. As you can see, the girls first semester had both a higher pass rate and mean score than the provincial scores. The girls in our pilot project classes did significantly better than both the school results and the provincial results. It is important to point out that not only do young women achieve higher scores with inclusive teaching, so do young men.

JUNE PROVINCIAL EXAM MARKS

Table 11.0

	<u>SCHOOL MARKS</u>		<u>PROJECT MARKS</u>	
	M	F	M	F
MEAN:	67.0	72.0	67.6	72.0
PASS:	79.0	91.0	50.0	100.0

SCHOOL: MEAN: 70.0 PASS %AGE: 86.0

PROVINCE: MEAN: 62.0 PASS %AGE: 71.0

The second semester marks represent the achievement levels for our second semester students and reflect an enrolment of 42 students. Once again the girls in our school and pilot project class had a higher mean score and pass rate than the provincial scores. This year we have experienced a higher drop out rate than normal in math, approximately 38%. This is also higher than computer science at 0% and physics at 20%. The teachers felt that the provincial math assessment was the reason for the increased drop out rate by their students. Our students' marks in class assessments did not vary from their math provincial marks but for some reason students viewed this assessment procedure with fear.

STUDENT ATTITUDES:

Over the course of the project we have asked students to provide feedback regarding the gender inclusive project. We did this informally through a variety of writing assignments. Below is an excerpt from one of our female students.

STUDENT RESPONSE:

"I have been a student at Nelson High and have been participating in three of the pilot project classes. This has allowed me to make many observations about our Gender Inclusive venture. I feel that I have benefited a great deal from my involvement and it has allowed me to develop confidence in a setting which traditionally favoured male participation. I am a step ahead of many others in this school because I had the use of the Macintosh Computer Lab where my English and Math classes were held. It was a wonderful environment for learning and development and I am very glad I was able to participate".

"All of my teachers did a great job incorporating the goals of the project into everyday life in the classroom. Group work was introduced at an early stage, which made it a lot more comfortable for those who found it difficult to open up. Before long, everyone was participating and sharing their ideas which motivated all of us and made the class more exciting and fulfilling. All of this meant a great change from the traditional, boring chalkboard lessons which I had been accustomed to into a challenging, effective way of teaching. It was really nice to see everyone taking part in discussions and problem solving because each one of us brought something different to the group that would benefit us all".

"I was also fortunate enough to be sponsored to participate in the Encounters with Canada program in Ottawa. The theme for the week was Science and Technology. We went on tours and listened to professionals talk about radiation, biology and AIDS and even got a chance to hold snakes and other creatures. This experience taught me many valuable lessons I never would have had at school. It was a chance for me to broaden my horizons and discover things I would never dreamed of knowing about. This allowed me to discover things about myself and motivated me to pursue my endeavours".

"I strongly support gender equality and I am glad that as a female interested in science, I was able to demonstrate my skills in an environment which treated everyone equally. I am grateful for the teachers who demonstrated this commitment to changing society, as it was these people who have allowed me to achieve what we have been after for so long. We still have a long way to go, but projects such as these are the only hope for students to conquer the never ending battle of

equality”!

In our final year of the gender inclusive project, the project teachers were awarded a Roy C. Hill Fellowship Award for their innovative teaching. This is a national award which recognises teachers who have devised new methods, approaches or teaching devices. It is quite fitting that the teachers were notified of this prestigious award on International Women's Day. Below are some closing thoughts from some of those teachers as they reflect on what they have learned through their participation in the project.

LAURA:

“Learning why these were effective techniques for my female students and for many of my minority students has changed my perception of my effectiveness in the high school classroom. Now, I find that I am always aware of what will be non inclusive in my teaching and that if I continue to use those noninclusive strategies I am eliminating an opportunity for some of my students to have a good learning moment”.

“I can now say that I believe all students have a right to equal educational opportunities and the empowerment process that goes with that. Gender Inclusive education provides them with that empowerment. I also believe that institutional change begins with personal change. This requires risk which is much easier to accomplish with the support of other colleagues. It requires a daily commitment with the knowledge that small daily changes lead to much bigger sustainable changes”.

“The biggest change comes within yourself. It is not a major shift in teaching, but a raising of awareness which promotes

consciousness of female students in your class. Openness to trying new methods flows as part of this heightened awareness. I enjoy teaching more, after twenty-eight years to be enthusiastic is great, the best part of school is in the classroom. I have more fun with my classes. It makes me smile and I feel revitalized. I want my students to see math as something alive and vibrant. I intend to make some more short steps in that direction next year”.

DAVID:

“I have learned that competition wins races and cooperation builds civilizations. I have learned that grading builds a form sheet and nurturing builds character. I now believe that girls acquire confidence more slowly and in a more fragile form. It requires a lot of positive feedback to make it unshakeable. Girls learn well together and learn well if the feeling in the room is positive. Girls will rarely display high marks because competition is not what it is all about. If you are sensitive to others, you do not mirror their failings. Finally, what works for girls works for all students, especially those most at risk”.

ELLEN:

“Being involved with the Project, I had an opportunity to discuss issues with people I never really discussed issues with before. I realized that we had something in common. We all wanted to make school a better place for kids and learning to be more active. We focused in on how the learning environment could be improved so that girls would be more involved in their learning. We all found the same thing. What worked for the girls worked for all students”.

"Being a member of the Project, I had an opportunity to attend workshops and to have access to resource materials that would not normally be available to me. I needed this motivation. Although within our group, we supported the change each one of us was making, these outside influences provided further encouragement".

"The toughest struggle, however, was other members of our teaching staff. The one thing that I had not anticipated was the negative reaction from my colleagues. When I became involved with the project, it seemed that I became an open target for other people's insecurity to change or their insecurity with gender bias issues. As far as they were concerned, everything was fine. Why rock the boat. The girls are getting the same education as the boys they told me. What I have come to realize, is that same does not mean equal. Hopefully, one day they will realize it too".

CHAPTER TEN

UNEXPECTED OUTCOMES

A teacher cannot build a community of learners
unless the voices and lives of the students
are an integral part of the curriculum.
(Peterson, 1994, p.30).

The focus of the gender inclusive pilot project was to include girls in our math, science and technology classes. During the third year of our project the project teachers began to comment that the strategies we used to include girls in our classes also worked very well for our boys. Nelson High is a multi-cultural school, with many "at risk" students and it seemed the strategies that we developed to make connections with our female students seemed to work extremely well with all of our students. Teachers reported that boys, especially from some minority cultural, groups seemed to be speaking more and commenting in their writing assignments how much they were enjoying class. Below is an excerpt from one of our male students.

MALE STUDENT RESPONSE:

"Coming from a visible minority, I feel very lucky to be Canadian. I read in the paper the other day about people from my country being beaten and tortured. This does not happen in Canada. In fact, I also read where its very important to give more jobs to people from visible minorities so we do not become cut-off. It is important to reflect the ethnic diversity in our workplace in order to increase racial harmony".

"I didn't want to participate in groups at first, because I didn't know anyone in the class, but now I really enjoy it. Nelson High is

what I think makes Canada a great place. Here, everyone gets along and I feel like I can say things in my group”.

One of the things we did not anticipate when we started five years ago was the number of other special projects and innovations that we would develop as a result of our participation in the Gender Inclusive Project. Once we began to think and reflect on our teaching practices and the learning experiences of our students we saw all kinds of ways to begin to connect student learnings. Below is a brief description of some of those other projects, who the funder was and the amount of grant money that was allocated to us.

SCIENTISTS IN THE SCHOOL

FUNDED BY: DEPARTMENT OF EDUCATION AND TRAINING

THREE YEAR GRANT: \$12,000.00 (total funding)

This particular program has been described in the chapter on role models and mentors.

LIFE EXPERIENCES

FUNDED BY: DEPARTMENT OF EDUCATION AND TRAINING

THREE YEAR GRANT: \$22,000.00 (total funding)

After further discussions concerning the issue of role modeling and mentoring I developed a program entitled Life Experiences. This program is designed to give all of our students opportunities to spend time with a scientist or other professional in their workplace. We have

specifically labelled this a "life experience" because we wanted to expose our students to the culture of these particular settings. Often our students do not have the kinds of exposures to the everyday workings of these types of professions and feel they do not belong.

We also thought that the teaching staff could also benefit from these types of experiences. One of the difficulties for the teachers in the project had been how to connect student learning with the real world. Once we began to meet and talk to people from different professions it became easier to see ways to connect course content with real life situations. The life experiences program became a way for other teachers in the school to have the same type of opportunity. Any teachers in the school who are interested in this program are released for one or two days to visit a business or profession of their choice to learn ways to connect their courses to a math, science or technology related field. They can also obtain funding to organize a class field trip or an activity based lesson somewhere outside of the school walls.

INTERNSHIP

FUNDED BY: HUMAN RESOURCES AND DEVELOPMENT, FEDERAL GOVERNMENT

THEE YEAR GRANT: \$240,000.00 (total funding)

We have developed a number of partnerships with businesses through our participation in the life experiences program. The internship program, funded by the federal government became a natural extension of our life experiences program. The intent of the internship program is to provide assistance to our students as they make the difficult transition from school to work. Students who are in their

final year at our school or a recent graduate can participate in the program. The intent of the program is to provide an opportunity for our students to work in a high level placement in an expanding or emerging company in our city. The students have the opportunity to see what types of skills and education are required to be successful in the workplace. The students enrolled in internship spend 3 weeks at the school preparing for their work placement, 13 weeks in the field interning at their position and then a final 3 weeks at the school refining their job finding skills. This is the first year of our program. We had 32 students, mostly female, complete their internship experience. This program has resulted in many of our students either deciding to pursue post secondary education or finding work with their internship company.

ALTERNATIVE ASSESSMENTS

FUNDED BY: DEPARTMENT OF EDUCATION AND TRAINING

THREE YEAR GRANT: \$16,000.00 (Third year still to be allocated)

As the teachers began to reflect and change their teaching practices they recognized that this should not be done in isolation from the assessment procedures they used. Very few teachers receive training in developing assessment tools of any kind for their classroom. This grant has been quite useful to release teachers to attend professional development sessions as well as provide them with time to develop alternative strategies. The focus this year has been on developing electronic portfolios and exploring alternatives to multiple choice testing.

LEADERS OF TOMORROW

FUNDED BY: DEPARTMENT OF EDUCATION AND TRAINING

THREE YEAR GRANT: \$16,000.00 (Third year still to be allocated)

One of the most important outcomes of our project has been the development of a student voice at our school. One of the additional things we attempted to do in the gender inclusive project was to sponsor students to various math and science related conferences and camps. The vice principal and I would interview students before deciding which ones would receive financial assistance. We were so impressed with the number of talented, dedicated students that attended Nelson High that the vice-principal and I decided to try and organize these students into what we called The Leaders of Tomorrow program. This program is open to all of our students who are interested in developing their individual leadership skills. We have attempted to encourage all kinds of students from our school to participate in this program not just those who are academically gifted. This year we had over 150 students participate in at least one area of the program. These students participate in numerous activities both at the school and in the community. They attend conferences on the future of education and regularly participate with our own staff at our professional development and change institute days. The principal keeps telling the vice-principal and myself that "if we're not careful we'll soon have the whole school signed up".

EXPANSION OF THE GENDER INCLUSIVE PROJECT

FUNDED BY: THE WALTER AND DUNCAN GORDON FOUNDATION

TWO YEARS: \$42,000.00

ORIGINAL THREE YEAR GRANT: \$75,000.00

At the end of our third year we applied and received additional Gordon Foundation funds to expand our project throughout the school. The expansion of the project focused on two strategies. The first was to encourage other teachers in any subject area to participate in activities that fell under the category of "making connections". In this respect we have experienced a great deal of success. Over the last two years of the project almost 90% of our staff has accessed funds from the gender inclusive project, life experiences, internship, scientists in the schools or the leaders of tomorrow program. My position was expanded to full time to coordinate all of the innovative programs in the school. The only criteria for obtaining money from these programs was that the focus of the student activity or teacher professional development be on connected learning.

The second strategy was to involve the entire staff and student representatives in in-servicing on making connections and the change process. At the end of year three I made a presentation to the entire staff on the gender inclusive project at one of our staff inservices. There seemed to be interest from the staff in what the project teachers had accomplished. Many teachers told me they recognized the importance of connecting with their students but were not sure how to go about it. I discussed the possibility of organizing our professional development days the following year around the theme of connected learning with our professional development committee and they agreed to give it a try.

Year four of our project we organized our professional development days around topics related to changing schools to make them more relevant to students. Facilitators and guest speakers led the staff through a variety of topics on the school change process and the need to

make schools more relevant. There were a variety of reactions to these professional development days. Some teachers became quite anxious about the possibility that change may occur in our school, some seemed to be open to the possibility of change and some became quite excited.

Ten teachers and one administrator who expressed the most interest in exploring the possibility of change attended a change institute sponsored by the Gordon Foundation. This change institute was organized to provide opportunities for schools to meet and discuss what was happening in their school and around the province. This proved to be a valuable experience for the ten teachers involved and they came back quite excited about what they had learned. At the end of year four I conducted an in-service session on the change process with those same ten teachers. At the end of that session they recommended that we run our own change institute at Nelson High the next year. They discussed this idea with the professional development committee. A decision was made that the professional development committee and the change group teachers would work together to run a "change institute" at Nelson High during year five.

We have just recently completed that change institute. During this past year we focussed on various issues related to the change process. In the first session we examined the beliefs we held about our own school and also celebrated our successes. Each department organized a poster display that told you something about the teachers in their department and the department's main activities, goals or accomplishments. In session two we took a look at what other schools in our province and across the country are doing to implement change. We set up phone links with these schools and had the opportunity to talk to

teachers about the activities they are involved in and some of their success and struggles. The third session attempted to identify specific skills our students needed to be successful. Teachers and student representatives worked in groups trying to decide what common skills students should have before they leave Nelson High. The last session focussed on the development of a direction statement for Nelson High and included some initial brainstorming to develop action plans for our various subject departments and the school as a whole.

We decided on a direction statement rather than a mission statement to reinforce the idea that change is an ongoing process and needs to be revisited on a regular basis. The direction statement will serve as a reminder to us that all of our initiatives need to be focussed on a common goal. Although, we still need to do some work on the exact wording of the direction statement, our first draft consists of:

That the administration and staff of Nelson High provide a SAFE, NURTURING environment for ALL students and teachers, where regardless of ability or beliefs, students and teachers can meet REALISTIC GOALS. With success, students and staff will have CONFIDENCE to be CREATIVE PARTICIPANTS in society, and continue to learn throughout their lives.

It is the principal's intention to provide all staff and students with this direction statement next September and ask that each teacher, department and student write specific actions they can take to move in this direction. The teacher plans of action will be kept by the administration and could be used as part of the evaluative process for our teachers. The department heads will be responsible for ensuring each department develops an action plan and the professional development

committee at the school will plan its P.D. days according to a larger school plan.

EPILOGUE

As this journey to collect images of teaching done differently draws to a close, a pause is needed to determine the distance travelled, the distance left to go, and what we have learned. A series of questions surfaces from an imaginary audience: What did you end up with? Was the journey worth it? What was learned that will help others proceed? What questions remain to be asked of others who choose this path?

(adapted, Wasley, 1994, p.202)

In the introduction, I outlined the process that led me to taking on this project. On a more personal note I would like to close with some thoughts where I share some of my reflections about the project we undertook and where this work might go in the future. I have chosen to do this by addressing four audiences. First, the many students who shared their stories with me during the past five years. Second, the group of teachers who allowed me to be a part of their classrooms and their lives. Third, our current Minister of Education and Training who is beginning to implement the reforms of the policy document "New Directions" and last to researchers who might be interested in undertaking this type of work.

As I indicated in the introduction I have chosen the format of letters. During the first years of the project I happened to have a conversation with my 11 year old niece about a comment on her recent report card. The comment said "Kaitlan is a bright sensitive child but does not speak in class". She talks incessantly at home so I remember very clearly the response she gave me when I asked her why she did not speak in class. "I do talk, but I use my school voice". When I asked what her school voice was, she responded in a faint whisper almost

inaudible to me and explained this was the way she talked in school. Her comment is a striking illustration that we learn at a very young age to speak in different voices.

Carol Gilligan (1982) discusses in her work, that she began to hear a different voice from women as they talked about moral decisions. Belenky (1986) writes that this different voice is more than a person's point of view. Belenky (1986) states that voice is a "metaphor that can apply to many aspects of women's experience and development" (p.18). She found that women often "speak about voice and silence" (p.18). She states that "women relate voice to their intellectual and ethical development; and that the development of a sense of voice, mind and self are intricately intertwined" (p.18). The letters that follow reflect the ethical and intellectual relationship that I have with each of the audiences. You might notice that the letter to the students reflects the teacher's voice of care and concern, while the letter to the project teachers is the voice of collegiality. The letter to the Minister of Education is the voice of frustration and the last letter, the voice of the researcher speaking to an unknown audience.

TO THE STUDENTS

To agree to learn from a stranger who
does not respect your integrity causes
a major loss of self. The only alternative
is to not learn and reject their world.
(Kahle, 1994, p. 134)

My original purpose in implementing the gender inclusive project was to attempt to add the voices of young women to our school. The example of my niece's silencing her voice and replacing it with another is not uncommon, especially for young women. Because we don't see ourselves in many of the classrooms or leading schools or in the books that we study, we come to believe that we are not important enough to be heard. Even though deep down inside we think what we have to say is important, we also understand almost intuitively that it might not be safe or wise to say it. And so we begin to question ourselves, maybe I'll have the wrong answer, maybe everyone will laugh at me, maybe the boys won't like me if I'm too smart and so we begin to talk in whispers.

I believed one of the most important things I could accomplish in this project was to help the young women in our school to reclaim their voice. To do this, the teachers that I worked with tried to provide classrooms where you would feel safe, respected and valued. I also believed it was important to encourage young women not only to reclaim their voice but their personal voice and so we tried to listen carefully to your stories. It is very difficult in our society to be an individual. Society is constantly telling young women what they should be. Schools often tell girls that they will be rewarded for being quiet, having nice handwriting, being pretty and following the rules. If you choose to be something other than that, you are subject to

becoming an outsider.

I hope those of you who wanted to pursue math and science never felt like an outsider in our classes and I also hope those who didn't felt they could make that choice without feeling judged. You have taught me that the issue of feeling like an outsider is an extremely powerful force. Many of you have made your choice to avoid math and science not because you have poor self esteem or confidence but because societal expectations have not nurtured the same sense of entitlement in you that it has freely given to boys. You are given messages every day that math and science is not a place for girls and when you rightly turn away, issues of low confidence and self esteem are given as the reason. This blame the victim attitude is something we tried to avoid in our project.

We believed that many of you have stayed away from studying math and science because we as teachers haven't made the necessary connections to your world. Instead, we have taught you that science is objective, rational, impersonal and disconnected. We have led you to believe that there is only one truth and this is called fact. I think it is the responsibility of all teachers to make a place for their students in their classrooms. It is also our responsibility as teachers to examine our own teaching practices from time to time to ensure that the methods we are using are current and still relevant in this ever changing world. I also believe that teachers play a critical role in the present and future choices of their students and we must do everything we can to help make your dreams come true.

We cannot do this alone, and you have taught us many important lessons. I must begin by thanking you for sharing your thoughts, ideas,

struggles and dreams with me over the last five years. Your contributions are what make up the most important part of this work: from the invaluable data that you provided during our assessment year about your experiences in math and science and the sense of connectedness you felt was missing, to the students who provided us with feedback throughout the project about what we were attempting to implement to change those classes, and finally to the students who have made up our student voice at our change institutes and professional development days over the final two years. I know what a risk it was for you to trust me, the teachers that I worked with, and even more to speak up in front of a staff of almost 90 teachers. I was constantly astounded at the level of wisdom, insight and creative thinking that you displayed. Two examples come quickly to mind. One of the first activities we did together as staff and students was to try to identify metaphors for our school. When you were asked to come up with an animal that described our school you responded with: "an oyster, because it appears to be plain on the outside but when you look inside you discover a pearl". The other example was at our third change institute session. We were attempting to identify skills that all students should have before they leave our school. Teachers prepared nice neat lists of items but once again the students outdid us. You constructed a tree of learning. Your student spokesperson explained to the teachers "that the trunk was the school staff because you support learning, the limbs and branches were the things students needed to continue to learn because learning helps you grow throughout your life and finally the roots were student initiative because without the roots to nourish learning nothing would grow". I'm not sure you realized the impact those statements had

on the teachers. I believe it gave some of them hope and inspired others to keep on working to improve our school.

At our final change institute we attempted to draft a direction statement that would assist us with this process of change and identify what our priorities should be. It is important to acknowledge that much of the tone and content of this statement came from you. I am sure that all of you noticed that one staff member at that session stated quite loudly, "that he didn't need any piece of paper to tell him what he should do as a teacher". I, however, want to thank you for reminding me why I became a teacher. Unfortunately, that sometimes gets lost in the day to day doing of the job. We get caught up in paper work, attendance and late policies, exams and staff meetings and lose sight of the real reasons we are there. Your questions of "why do we have to learn this, and when will I ever use this" are important ones and ones that teachers must begin to answer.

Often as teachers, we talk about the disinterest of students or their lack of skills but seldom are we able to relate the issue of disengagement to our own teaching practice. McLaughlin & Talbert (1993) tells us that most teachers are concerned with maintaining standards and therefore feel they must lower their expectations for their students. As a result they fail to examine their own teaching practices. He also tells us that this process of self examination is often very scary for teachers. They feel trapped by the old ways and methods and can't see other alternatives. Because teaching is an isolating activity teachers often have no opportunity to explore other possibilities. The teachers who participated in the gender inclusive project took the risk of self-reflection and change because they wanted to provide a better

environment for you, their students.

Throughout the project, many of you in many different ways have stressed the importance of providing a safe, nurturing environment where all students have an opportunity to use their creativity and build confidence. I believe we attempted to do that in the gender inclusive project but we still have a long way to go as a school. Your input has emphasized for me the importance of focussing on school reform from the perspective of student learning and experience rather than school restructuring. Sometimes as teachers and administrators we tend to think of school as a system, and students are merely one other piece that has to fit in. The system treats you as an object that can be slotted, timetabled, tracked, controlled, assessed and stamped with the school's approval upon graduation. This systems approach has become a priority with our present government and some segments of our society. They assume that the changes that need to be made should only be those things that can be measured. I do not mean to imply that those things are not important but you have reminded me they are not the only reasons for attending school and quite possibly not even the most important ones.

In our society, we have a tendency to polarize attributes and there is often an assumption that excellence can only be attained when you also have conditions like control and competition. If you think about it more closely, it only makes sense that if you provide an environment where students feel secure and supported they will display more self-confidence and achieve at higher levels. Also, if teachers display high expectations and confidence in each individual in the class, it is my experience that students will respond to the best of

their ability. You have certainly demonstrated through your academic as well as personal achievements that excellence and caring are not mutually exclusive.

I have also come to understand that if we do not begin to pay more attention to you as individual people, with your own questions, hopes, dreams and struggles needing the support and understanding of teachers, we are headed towards an even more inhumane society than we already have. We may begin to produce student outcomes but those outcomes could quite possibly be devoid of human feelings and lack respect for individual strengths and talents. The answer of narrow academic standards will not produce the "creative, confident human being" that you have spoken about so many times.

You have taught me that it is critical for us to guard values such as care, concern and ethics in our teaching. It is as Noblit, Rogers and McCadden (1995) describe, "the glue that binds teachers and students together and makes life in classrooms meaningful" (p.680). In fact, before schools became large impersonal factories controlled by hierarchies of bureaucracy, teaching was often carried out in small groups or with one on one mentors. It seems we knew on an intuitive level at one point that it was necessary for teachers and students to develop caring relationships long before we rediscovered the importance of making connections. Researchers like Weiler (1988) would also point out that "it is a commitment to human values that gives teachers a sense of their own worth and the value of their work, even in a society where it is often devalued" (p. 152).

There has been little current research in the area of caring classrooms for teachers to read, but Noblit, Rogers & McCadden (1995)

have found that caring is an important value or a belief in our schools. They tell us that it should guide everything we do in schools from the ways we "instruct, set policy and organize the day and challenges us to first discover it in the way we relate to our students" (p.680). It is this caring relationship with teachers that was the central focus of our project. Often, you described good teachers as those who showed an interest or who cared, teachers who talked with you not at you.

The teachers in our project came to know with your help that schools should be places where students are empowered. They, in fact had many discussions about the issue of power and how they had changed their perspective on teacher-student relationships. All of the teachers at the beginning of the project were afraid of changing their classes because they were unsure about losing control or the power they felt that they exercised over you. What you have taught them is that it is not necessary for them to control your learning but rather facilitate a process where you take shared responsibility for your education. I believe the opportunities that you had to talk to me and the teachers about issues of importance to you helped break down some of the barriers that existed in the classrooms. All of the teachers in the gender inclusive project tried to see teaching not just in quantifiable results, test scores or mastery of facts. Instead, they tried to provide classrooms as places where your intellect was challenged, where meanings were questioned and analysis and criticism of society, a text, assignment or even themselves, were encouraged. In other words, you were encouraged to speak your mind.

The importance of talk was an another important issue that you raised in the project. It was through the creation of dialogues between

teacher and student that you first became comfortable revealing your real thoughts about us as teachers as well as the teachers revealing some of their lives to you. Communication became a two way street where both teachers and students had to listen. Talk became as Noblit, Rogers & McCadden (1995) describe it "the currency of caring" (p.684).

Noblit, Rogers & McCadden (1995) tell us that rituals are things that students come to expect to happen on a regular basis in teachers' classrooms. You taught us the importance of reexamining our classroom rituals. For example, teachers whose rituals include: taking attendance, documenting lates, assigning homework questions and due dates without discussion give very different messages to students than teachers whose rituals are: greeting the students by name at the door each morning, writing letters or participating in question and answer dialogues, relating student work to their world and soliciting student opinions. These rituals were more than just ways of doing things. They became concrete examples of our beliefs and interpretations of teaching that make up the culture or the climate of our classrooms.

Another ritual that you have taught me is this curious dance of acceptance and resistance that you play. As adolescents, you are engaged in this struggle between accepting authority, rules and boundaries and at the same time resisting them in an effort to find your own place. I believe one of the reasons why our project was successful is that we attempted to provide you with classes that better reflected the image of your own place. It is obvious to me that making connections is important to all students and most important to students who have been the most ignored and marginalized in our schools. The important thing we accomplished in our project was more that we

attempted to make those connections with you rather than the specific strategies we utilized. I hope that many more of you felt at home in our classes and therefore the need to resist was lessened. For young women, the need to resist has been demonstrated by you traditionally withdrawing from us as teachers and our classes. Society has taught young men that their resistance should be demonstrated through rebellious or even violent acts. In many ways you exhibited your acceptance of our efforts by your participation and creation of safe, respectful, creative and academically excellent classrooms.

Finally, I want to thank you for giving me hope, inspiration and at times the courage to continue my work. There have been many examples of irony that I have encountered during this project. One of the most interesting to me has been that certain segments of the teaching staff viewed our project with fear, resistance and at times hostility but I take a great solace in the fact that during the entire five years of our project there were no times when any students, male or female, questioned the value, intent or need for what the teachers were trying to change in their classes. You accepted our attempts with open minds and hearts and participated with sincere interest. I started this project because I believed that the only hope for gender equity was through educating young people about the value of mutual respect for both genders and a better understanding of our differences and mutual strengths. You in turn have done much to educate the teachers and myself about these very issues. Your open mindedness, tolerance and willingness to experience with us a different culture in our classrooms gives me renewed hope that this goal will eventually be reached and that the future is indeed in caring hands.

TO THE TEACHERS INVOLVED IN THE PROJECT

My idea of a teacher was one who followed the rules, who arrived on time, who listened during staff meetings but did not raise dissenting opinions. I filled out my lesson plans, and did the things that were expected of me so I would be labelled a professional. My responsibilities were to teach my students as best as I could and be familiar with my course outlines and cover the material for the exam. I knew I was doing a good job from my evaluations. I knew I was doing a good job because I kept tabs on attendance and lates. I knew I was doing a good job because my room was quiet and the desks were in straight rows. I knew I was doing a good job because most of my students passed and very few parents complained. I knew I was doing a good job because I did things by the book. Did my students know?

(Adapted, Wasley, 1994, p.149)

Recently, we had a group meeting of the gender inclusive project to celebrate our successes and discuss what we have learned over the past five years and where we might go next. Each of you expressed in your own way the fact that it would be impossible for you to go back to the way you taught before the project started. David described it as "once you have looked into the sun, however painful that might be, it is impossible from then on not to know the truth". It seemed at that point that the meeting became a wake where each of you took some time to talk about what were the most important lessons that you had learned.

Richard spoke about the importance of relationships. He confessed that previous to being involved in the project he had never understood or appreciated how important relationships were to his female students. Although he expressed a great deal of frustration that some students chose not to take his class or dropped out because their friends were

not there, he felt that he now at least understood their reasons.

The issue of relationships seemed to be something that was of interest to most people in the group but for different reasons. Many of you credited the support of the group itself for the success of your work. Deidre stated that "I can't work in isolation. That's the one real frustration I have with teaching. I needed the help of the group to give me ideas and help me work out my problems. Give me the push and I can perform but I also need the support and assistance".

Ellen related a story about her first impressions of the school. "When I found out I was coming to Nelson High I was really looking forward to it all summer. I had heard many good things about the school and I was very impressed when I came for my interview and school visit. I was totally unprepared for what happened during my first few months at the school. I could not believe some of the things certain staff members talked about or said. I was shocked at the level of sexism, racism and homophobia displayed by certain groups. It scared me so much that I spent most of my first year at the school hiding in my classroom with the door shut. It was only when I became involved with this group that I felt it was safe to talk about my ideas. Have you noticed that I talk more now"? This was greeted with a spontaneous chorus of YES!

The importance of trust and collegiality is one that you raised many times in our group meetings. David identified the need to take on these changes together by describing it as, "In the beginning it was like we were holding hands in the forest at night. We didn't know where we were going, but we wanted to make sure we all went together". This issue has also been discussed in the literature. Wasley (1994) states that there are serious limitations when teachers are isolated within

their classrooms. She explains that you are restricted by your own limitations but if you work with other teachers you can share information and ideas.

The literature also talks about the benefits of closer relationships between teachers. "Teachers who get to know one another and become much closer make work a lot more fun. You can trouble spot for each other, validate each other's work and provide better support for kids" (Lieberman, 1995, p. 128). When I think back on our group meetings over the years how many times did Richard say "I just got an idea from this group that I can use tomorrow"? It seems that the trust and collegiality that we shared formed a culture of honesty and directness where we could as Deidre described "fiercely disagree at times but still remain friends".

The issue of friendships was one that also came up in our discussions. Some of us have described the relationships between our staff members as superficially friendly. The issue of superficially positive staff relations or contrived collegiality is one that Norris (1994) also found. He states that "ineffective schools are ones where individual teachers pursue their own goals without any school wide consensus. This lack of consensus results in competing factions within the school, and groups of teachers may form cliques which engage in ongoing power struggles. This is compounded by the issue of teachers being isolated from each other afraid to discuss ideas or ask for help" (p.3). Fullan and Hargreaves (1990) relate teacher isolation to feelings of powerlessness. They state that:

When teachers are afraid to share their ideas and successes for fear of being perceived as blowing their own horns; when teachers are reluctant to tell others of a new idea; when teachers are afraid to ask for

help because they may be perceived as less than competent; when a teacher uses the same approach year after year even though it is not working it limits growth and improvement. The limited access to ideas and practices institutionalize conservatism.

(p.39-40)

David talked about the difficulty of being the only member of his department who was officially a part of the project. He felt this was doubly difficult for him because he was male and many members of his department took great delight in either questioning his masculinity, treating him differently or shutting him out of conversations where he had previously been welcome. He felt he now knew what it was like first hand to be an outsider.

The theme of insider/outsider is one that I have observed in more than one context in our project. I explained how I started the project because I felt that I was an outsider; we also know that many of our students have always been outsiders in our classes. The experience that David is going through is slightly different. He was originally accepted in a group and later cast out so to speak because he no longer reflected their beliefs. I think many of you in the project also experienced this but maybe not to the extent that David did. I think this is partly due to the fact that the group that David was a part of, was a group that held a great deal of power in the school at one time. When he began to display beliefs contrary to that group they began to see David as a threat to their power much in the same way as they viewed me.

The connection between who has power and insider/outsider relations is very interesting and something that has been talked about in the literature on school change. Goldsberry et al (1995) observed in

their study that barriers emerged that created insider/outsider relations when a particular group in their school received grant money to carry out a change project. They explained that "even though they had met with the staff and offered everyone the same opportunities so no one would feel excluded it still created a school-within-a-school situation" (p.151). Goldsberry et al goes on to describe that "other teachers began to view them as different because they were being successful and at times labelled them as arrogant" (p.151). This phenomenon is almost identical to our situation. I know all of you at some point talked to me about how staff members who you considered to be your friends suddenly were treating you differently. If you remember, we started the project on a small scale and opened it up to anyone who might be interested. Although some people expressed some interest and support for the project, no one was beating down our doors to join the project. The original administrator was supportive only on a superficial level and in fact related on a personal level to the group of teachers who were most threatened by our presence. It was only after the administration changed and the most resistant group felt the new administrator supported and in fact in many ways highlighted our project that any mention of exclusion was raised. Even then it did not seem to make any difference how many times we invited other people to join, it seemed that they preferred to believe that they were being excluded.

Ross & Webb (1995) also found a connection between staff relations and power issues in their study on school change. They describe the school they worked at as superficially having positive staff relations. As they began "to examine the micro politics of the school they saw hidden tensions. They attributed these tensions to the fact that a

group of teachers was working on a school change initiative and many of the veteran teachers resented their work. Their resentment was closely linked to the fact that the change group was close to the seat of power, the principal" (p.67).

I know there were many times during the project when I questioned whether we should have started with a small group of committed teachers and gradually added others. At the time, our rationale was that the idea of implementing an equity project would be a threatening thing for many people to deal with and so making it voluntary would reduce the tensions. The other alternative was to wait until the majority of staff bought into the idea but this approach also has limited success. Researchers such as Patricia Wasley (1994) have observed that "starting with the whole group does not solve the issue of insider/outsider relations. What occurs is that some teachers will inevitably progress at a faster rate and eventually the group breaks down into smaller groups creating the same issues" (p.67). Wasley credits this psychological phenomena to group dynamics. She argues that "whenever a select few, even if they are volunteers, choose to do something out of the norm, difficulties seem to erupt. Those doing something new are perceived to be special by those not involved" (p.67).

How then do we change schools when frequently if not always the existing culture does not support it? Norris (1994) states that "school leaders can approach school improvement through cultural change by becoming familiar with the values and beliefs embedded in the school and by shaping the culture in new directions" (p.2). This is one of the strategies we attempted when we expanded the project into the entire school. If you remember our first session as an entire staff involved

examining our beliefs as individual teachers and as a school, the second session focussed on what actions we might take to reflect those beliefs and our final session was trying to arrive at some consensus of beliefs which would formulate our direction statement. The plan for this fall involves each teacher, department and the school to develop an action plan that will support our direction statement.

Pulling the staff together or applying gentle pressure to reshape their individual bubbles (the concept of bubbles will be developed later in the dissertation) will take a special kind of leadership. Martin (1990) in her analysis of leadership states that:

As we approach a new millennium and embrace an age of global communications we must shake off the residues of sexism, racism, elitism and oppressive power. The world is experiencing a global paradigm shift that will result in the breakdown of elitism and move away from hierarchical forms of organization.

(In McCormick, 1994 p.144)

McCormick (1994) states that "changes in organizational paradigms require a drastically different type of leadership and a reconceptualization of power" (p.144). Dunlap and Goldman (1991) expand on this by stating:

Power as a system of facilitation is characterized by mutuality and synergy within the structured organizational context of public schools. Facilitative power replaces neither hierarchy nor authority. Instead, we suggest a shift in perspective. Thinking of power as facilitative rather than hierarchical may better enable us to identify and predict what sorts of leadership activities actually occur in schools.

(p.7)

Seven years ago I completed my master's thesis which dealt with the concept of leadership. In that work I argued among other things that many talented teachers did not pursue and/or attain leadership

positions in schools because they did not see their values reflected in those particular types of jobs. Also, the educational organizations themselves are very resistant to change, and one of the most effective means of maintaining the status quo was by ensuring only people who reflect its values are promoted within that system. At the end of that work I urged teachers who chose not to pursue administrative appointments to consider that they had an important role to play as the educational leaders within their own classrooms and schools. I believe when the Gordon Foundation started funding grassroots programs initiated by teachers they tapped into that previously ignored resource of visionary leaders within the school, and you were some of those people. The successes you had in changing the participation, achievement and attitudes of young women towards math and science was due in a large degree to the fact that you as individual teachers provided an atmosphere of respect, support, encouragement and valuing to all of your students. You learned to include your students in the learning process and act as facilitators of student learning rather than controlling them.

My role was to help you transform your visions into reality or be the transformational leader of the group. One of the strengths of a transformational leader is the ability to provide an environment for change. A transformational leader or a change agent must also understand that they can not be so blinded by the intensity of their vision that they forget to pay attention to other members of the group. Part of educational change is coming to grips with the multiple realities and beliefs of the people who are participating in the change process. Any leader who decides what the change should be and acts in

ways that may exclude others is bound to fail. Change agents who are unable to adapt their vision are as rigid as the defenders of the status quo.

It will come as no surprise that if we expect teachers in general to change their attitudes and practices, we need to provide them with the same support, respect and inclusion. I know that type of working environment was essential to you. Many of you spoke in the group interviews with an outside evaluator of the importance of my not being judgmental about your attempts to change and treating you with respect and support. Deidre phrased it as: "I was a slow starter. I would not have gone as far as I have if it hadn't been for Cheryl helping me along at my own pace and in my own direction. I never felt like I was failing, there was always support".

This supportive environment does not exist for most teachers within our system. Teachers are regularly treated as children who need to be closely supervised, monitored and controlled rather than as professionals worthy of respect and trust. Until this fact changes it will be difficult to transform our system in any meaningful way. All of you at some point in the project raised this issue. Every time one of you felt disrespected either by the system, an administrator, a fellow teacher or government reforms, I could sense you pulling back just a little bit in terms of your commitment or time.

Watts & Castle (1992) would agree. They argue that "we need to redefine the role of teacher to include being a decision maker and that includes thinking about how a teacher's time is organized" (np). They argue that teachers' time needs to be more flexible. They state that "there has been a traditional assumption that teachers need to be

managed. They have not been trusted to use their non-instructional time wisely and so have had virtually no control over their time and its use" (np). This was one of the major concerns that you raised in our group meetings. It seems that the administrators at the school and the division level are placing more and more restrictions on non-teaching time and at the same time expecting teachers to donate more and more of their personal time.

I think we would agree with Louis & Miles (1990) when they say, that if teachers were more involved in how their time was used it would significantly improve their sense of morale and professionalism. Although more time is required for school reform it is equally important how that time is used and who is in control of it. They provide evidence that the solution is:

to explore solutions which question the strength of the divisions between administration and teaching, between development and implementation, and which question the bureaucratic impulses that support such divisions. In particular, I suspect it would be more helpful to give more responsibility and flexibility to teachers in the management and allocation of their time and to offer them more control over what is to be developed within that time. Once we acknowledge what time means for teachers, there seems to be a strong case for giving time back to the teacher.

(1990 p. 319)

Liebermann (1995) found that teachers need to redefine their roles, but this requires extra time. She suggests we examine teachers' workloads, assignments and our expectations of what teachers can realistically accomplish. Time is also considered to be the currency that teachers trade in within our schools. It is something that teachers both freely give to their students and expect in return as acknowledgement for their efforts with their students.

The importance of time as currency was something that you raised at one of our group meetings. If you remember Richard had asked to leave the school to attend a personal function during semester break and his request was denied. This resulted in not only Richard pulling back on his donated personal time but caused all of you to respond with anger towards the administration responsible for the decision. I remember being somewhat surprised at the level of hostility that was directed toward the administrator as a result of that decision. It was only after I thought about the circumstances for a while that I realized that as the coordinator I was able to schedule my time or have some control over my activities. I did not relate to the issue of time on the same level as the rest of you who did not have that luxury. It was that particular meeting that made me realize how critical an issue time is to teachers.

The amount of time that teachers have to devote to change initiatives is one of the most important factors in the success of any project. Watts & Castle (1992) state that "time or the lack of it is one of the most difficult problems faced by schools engaged in restructuring. Teachers need time to meet and discuss issues, concerns, visions and plans and most importantly to reflect. Reflective time is described as time to take a step back from the process to reevaluate the direction we are going and to formulate new plans" (np). This presents the problem of time away from students. Watts & Castle (1992) again tell us that the "traditional view of teacher's work is governed by the idea that time with students is of singular value. Professional development is somehow not seen as related directly to instruction. Not surprisingly, many teachers often experience guilt when they are out of

the classroom despite the value of the professional development opportunities" (np). I know this was a major concern for you as teachers. There were many times throughout the project that I encouraged you to take a day to explore a topic, read about an issue or think and reflect about a problem you were having. You always gave me the same response: "I'd love to but I can't afford to be away from my class".

We tried to solve this in many ways. We talked about scheduling tests in more than one class at the same time so we could meet and talk and leave someone in charge without taking away teaching time. We also considered utilizing our grant money to buy back additional teachers for our school who could be assigned as a regular teaching partner in the classroom. This would enable the assigned teacher to leave the classroom when necessary with as little disruption to students as possible. We also talked about the necessity of timetabling teacher time as part of our regular teaching duties.

If time is such a critical factor and one that teachers have very little of, it is not surprising that so many educational initiatives fail. As teachers, you have also identified that it is essential that the change projects have time to evolve and grow. You talked about the fact that you have to nurture change along so it can be self-sustaining. There has to be the recognition that changes in any big structure take a long, long time. Richard told us that "if we had pulled the plug after the first two years I don't think anything would have been different or self sustaining but now we are changed forever".

To sustain this change takes an ongoing commitment. Many times throughout the project I was impressed by your strong commitment to your

students and your willingness to press on even under difficult circumstances. I believe the reason you have sustained your efforts for as long as you have is that our initiatives have from the very beginning been student centred. Cawelti (1995) in his study on high school restructuring found that the term restructuring means very little. He argues that some educators have come to focus their change initiatives only on student achievement. He contends that "no single pattern for changes will work in every high school, owing to different traditions, culture, community expectations and capacity for renewal. He feels that using a variety of approaches is more effective" (p.13). I'm sure all of us in our project would agree with this statement. This was one of the central premises in our work; that every teacher would approach the change initiative in a way that made sense for them and their students. Cawelti (1995) refers to research that would support our view that as teachers have begun to play a more significant role in implementing the multiple strategies needed to improve student achievement, the days of tightly controlled management should come to an end. Just as we found that the key to changing our classrooms was to share the power of learning with our students so do schools have to share power with teachers.

We know that extra work and many risks are involved in fundamentally changing the way the system works but your efforts do pay off in the end and so we continue on with our efforts. As our meeting ended you already were making plans for next year. All of you commented on the importance of taking what you have learned a step further. You talked about the need to work on connecting curriculum, instruction, assessment and technology together so students begin to see their

learning as a process. To do this some of you want to continue on exploring alternative assessments for your students, some of you intend to improve your computer skills while others have expressed an interest in teaming with other teachers in some cross-curricular activities. Since this will be our last meeting together before I begin my new job I would like to say that I know whatever approach you take you will continue to improve the quality of learning experiences for your students. I wish you the best of luck!

TO THE MINISTER OF EDUCATION AND TRAINING

Schools will change when and only if teachers change

(Sizer, In Wasley, 1994, p.207)

It is with mixed emotions that I respond to your letter congratulating me upon receiving the Roy C. Hill Fellowship. In your letter you stress the importance and need for innovative teachers like those in our project in Manitoba classrooms. The irony I feel upon reading those lines exists on many levels.

As a feminist woman working for change within our schools, I must say I am deeply concerned about the content direction of your latest policy document "New Directions". The very name illustrates what I mean by irony. It is anything but "New Directions". It is quite simply the rewriting of old ideas, beliefs and values. Although the document includes passing references to cultural and racial differences within our province, the issue of gender is once again completely absent from the discussion. Although this does not surprise me for the issue of gender is generally absent from any educational discourse, I am particularly dismayed that you seem to be unaware of the research that documents the gender inequities that currently exist within our school system. It seems to me that if you or members of your department understood the fact that women are either absent or marginalized in every aspect of our educational system, you would not attempt a major educational reform without addressing these issues.

Girls and young women face bias and discrimination every day in every classroom, in every school in our province. This bias and

discrimination is evidenced through the curriculum, teaching strategies, classroom environments, access to technology and assessment procedures utilized by most educators, supported and in some cases mandated by your department.

What does this mean in light of your curriculum reform? As discussions surrounding gender have not yet informed your decisions surrounding curriculum, the move towards outcome based curriculum and tests of standards ensures that what students are expected to know and to be able to do will reflect society's masculine values. The curriculum that you intend to disseminate throughout our schools will once again be almost completely focussed on the experiences, beliefs, values and lives of certain groups of privileged men. Women's lives and contributions will continue to be excluded or marginalized in every subject area that students study, in effect ensuring the silencing of women's voices in our classrooms. In response, many young women will reject these traditional and overtly masculine forms of thought in which they are marginalized by continuing to withdraw from those very same classrooms.

Those who persevere will not only be subjected to an overtly racist and sexist curriculum but will also be judged by assessment procedures that are biased in favour of white males. Surely, the evaluation team in your department who work on developing these tests of standards must be expected to be current on the latest research on test bias. If not, I would suggest they read the research being conducted in Australia, Scotland, England or our own project results on the provincial math assessment to find that certain types of questions favour a particular gender. You may respond that adjustments will be

made in those areas but the research results are further compounded by issues of culture and race. After spending the last five years working on equity issues in our school I question whether it is even possible to produce a provincial assessment that is fair for all students.

As I am interested in the issue of gender and assessment I reviewed the provincial English exam. Upon reading the selections for the process writing task, I was appalled at the obvious gender, cultural and racist bias in the selections distributed by your department. I was also saddened that as a school that is committed to inclusive education we were forced to subject our students to participating in this exam. The selections reflected an overtly white, eurocentric, male perspective. Seventeen of the twenty-two authors were male, the protagonists of the selections were mainly male and some of the selections contained racist comments about aboriginal people. Although the theme of this section was Awareness, I do not believe the people who constructed this assessment were testing the students' understanding of irony.

This raises many fundamental questions concerning inclusive education. This assessment obviously showed little or no respect to female students, or students from different racial or cultural backgrounds. It also showed no respect for the learning process itself. The purpose of assessment should be to enhance student learning. What is to be gained by our student population when they engage in assessment procedures that are foreign to their lives and experiences and also are never shared with them? Why does your department deem it necessary to cloak these assessments in secrecy? Is it because you believe that excluding students from the assessment procedure yields fair results?

If so, this demonstrates a lack of understanding of the purpose of assessment. These procedures were neither fair for all students nor authentic, nor can they contribute to student learning if students never see their results. One begins to wonder whether their sole purpose was simply the perception of public accountability.

As a teacher, I have no problem with being held accountable for my actions. You need only review the results of our gender inclusive project to understand that if you provide a safe, supportive, respectful and inclusive environment for students to learn in they can achieve many different kinds of outcomes including excellence. I would suggest that to accomplish similar outcomes with schools in our province you need to provide the same type of conditions. When I requested examples of research that your reforms were based on I was sent articles that talked about many of the same issues that I am raising. The article from your department entitled "Assumptions of Standards Based Reform and Their Implications for Policy and Practices" lists as Assumption number 6:

Standards based reform requires and promotes a necessary climate of trust among various elements of the educational system. Much of standards based reform is dependent upon the exercise of sound professional judgment. The determination of appropriate curriculum and learning experiences; the diversification of instruction to meet the needs of individual students; the judgment of quality in student work in new assessment contexts; and the assessment of the performance of professionals are all examples where wise professional judgments are required if the reform is to succeed.

(LeMahieu & Foss, 1995, p.12)

This article goes on to tell us that one major conceptual change that must be implicit within reform is that it prizes the judgment of professionals. It states that we must question to what extent policies are designed to enrich, enable and empower professionals rather than

control them. I must confess as a teacher in our province I do not feel enriched, enabled or empowered by the policies of your government but I do feel controlled. Your document on "Enhancing Accountability, Ensuring Quality" illustrates many examples of teacher control, from salaries to evaluation.

The issue of control is not a new one for teachers or schools. There have been many studies done on school reform and change. Cuban (1985) in his analysis of schools, concludes that schools in the end haven't changed very much at all. Your document seems to confirm his analysis. It appears that school reform to your government really means a return to the status quo where students meet in a gymnasium to write departmental exams, where some students are held back because they do not meet a very narrow view of what students should know and be able to do and schools are to be run on the principles of order and control.

The issue of control in schools, like accountability, is something the public at first glance may openly embrace because of the perception of failing schools and an increase in violence. However, Hargreaves (1994) quotes researchers who indicate that schools organized on principles of control and competition have never been particularly successful. As a feminist woman, I find the issue of control to be particularly important. The teachers in the gender inclusive project found that it is not necessary to control students to improve their learning or produce results. I am as concerned as any one about the levels of violence within our schools and society in general but I believe that schools are contributing to that violence by not providing an atmosphere of community, respect and trust within their walls. As long as we give groups of students within our school messages that they

are not important or relevant, they will resist the notion of belonging and find ways to rebel against it. I believe your "New Directions" policy will give very strong messages to our young people that many of them, especially young women, are not valued.

The issue of control was raised in another article sent to me by your department. In that article, "Reframing the School Reform Agenda", Darling-Hammond (1993) states that:

education requires a new model for school reform, one in which policy makers shift their efforts from designing controls intended to direct the system to developing the capacity of schools and teachers to be responsible for student learning and responsive to student and community needs, interests and concerns. Capacity building requires different policy tools and different approaches to producing, sharing and using knowledge than those traditionally used throughout this century...

(Darling-Hammond, 1993, p.754)

In order to move from control to capacity building I suggest as Charol Shakeshaft (1991) does that we focus on the need to rethink schools not reorganize them. The process of rethinking schools involves asking some of the big questions. What is it that all students need to be successful contributing members of our society? What knowledge base is needed to meet the needs of our society, of our students, whose knowledge is it, and is it possible in this information age to even contemplate what it is necessary to know? Part of the rethinking process is to question the very nature and purpose of our schools. I would agree with Connell (1982) that we need to engage, not control students in the learning process, making education a lifelong and relevant pursuit.

How can this be accomplished? I believe as Hargeaves (1994) does and as our students at our school have taught us that schools must be more relevant and connected, and they must foster a sense of community and imagination. We need to rethink the traditional modes of teaching that we have used to disseminate knowledge and develop higher order thinking skills whereby students can become critical consumers of education. Yet your "New Directions" policy document seems to indicate that only competition and meritocracy can produce excellence. I would argue that strengthening our sense of community and beliefs in tolerance and respect for others within a supportive learning environment will lead us to a shared vision of excellence, one that includes concepts of caring and concern as well as improved student performance. Jane Roland Martin (1986) speaks to us about moving from the concept of the educated man to educated person while Nel Noddings (1992) advocates for inclusion of care and ethics within education. I would hope you can recognize these as equally important outcomes for our students.

To implement these types of changes within our schools we need to pay attention not only to what we should change but how we go about it. The very physical and organizational structures dictate many of the pedagogical principles of schools. Secondary schools in this province are predominantly fragmented, isolating places where teachers own their classrooms and students are shuffled from place to place at the sound of a bell. There is very little opportunity for collaboration or professional discussion amongst teachers or between teachers and your department.

We have found in our project that change can be a difficult, complicated process that requires time and support. It is not as linear

in nature as the schematics in your reports indicate. Meaningful change in schools must be addressed in a variety of ways dependent on the context of each individual school community. Some of the most successful changes have occurred at the grassroots level within individual teacher's classrooms as you acknowledge in your congratulatory letter. For the success of our project to be spread throughout the province, your acknowledgement of our work needs to be more than a congratulatory letter; it must be the understanding that ending gender bias in our schools is an important issue. It is also important to acknowledge that we as teachers are trustworthy and willing to share our successes as well as struggles with you in order to improve our schools. If you are willing to work collaboratively with educators there are many initiatives that can be carried out to accomplish the goal of inclusive education.

I strongly recommend you reinstate the women's consultant position within your department. This reinstatement should include a review of the responsibilities and requirements for the position. Previously it was filled on a part time basis by someone who had no formal training in the area of gender issues in education. It should be the mandate of this government through this position that this province take the first steps in ending gender bias in our schools.

To accomplish this the government must have the political will to provide the necessary supports and financial assistance. The women's consultant working in collaboration with schools must develop stated goals and policy to implement inclusive education. This could be more readily accomplished by establishing a network of women's consultant positions in the various school divisions and within individual schools

themselves where size warrants it. In addition to the department having stated goals and policies it should be the expectation of your department that each school will have one equity goal per year that they must work towards attaining.

Your government can also play an instrumental role by empowering the women who work within our schools. Your department should ensure that qualified women are supported and encouraged to seek leadership positions. Thurston, Clift & Schact (1993) argue that we need to rethink our schools in order to provide opportunities for principals to focus on instruction rather than management. You also need to ensure that there are strongly worded policies ensuring that all persons working within the field of education can be assured of a safe supportive working environment free of discrimination based on gender.

The Department of Education and Training also needs to work closely with teacher training programs to revamp their educational programs to reflect inclusive teaching methods. As well, there needs to be a comprehensive program of teacher inservicing and training in the area of inclusive teaching strategies, classroom environment and assessment procedures. Measures such as these will require the government to rethink its policies concerning cuts in professional development time for teachers. With the ever increasing demands made on teachers your department must look at creative ways of providing time for teachers to familiarize themselves with inclusive education. This may include such radical ideas as timetabling teacher time within the school schedules. I would refer them to Watts & Castle (1992) for suggestions in this area. These supports are necessary as it is futile to acknowledge that change must take place but not provide the supports

necessary to make it happen.

I realize that one of the policies of this government is fiscal restraint and cutbacks, especially in the area of public education. I do not believe it is simply a matter of money but rather an issue of priorities. I would also argue that the amount of money required to implement inclusive education is minimal in comparison to the depth and scope of the gender bias that exists in our schools. I would therefore question the priorities of this government when it continues to ignore the experiences of girls and women in our schools. It is the women in this province who can no longer afford to ignore the inequities in the content of their education and the lack of opportunities that result from that education by allowing the continuation of the allocation of funds to a system that perpetuates inequities based on gender, class, race and culture.

Over numerous decades many reforms have sought to improve schools by adding course requirements, increasing standards, mandating new curricula and developing stricter assessment procedures. Many of these reforms have been based in a faith that the organization has the power to rule human behaviour to produce certain outcomes. However, we know that students construct their knowledge in a variety of ways other than through instructional packages. Researchers like Leithwood (1992) state that "reforms that rely on transformative power where individuals rethink their practice rather than hierarchal power have a greater chance to succeed" (p.8). This was also evidenced by our project. However, at this point in time we have different theories of school reform working against one another. Darling-Hammond points out that "ironically, the understandings about human learning that have informed

the development of new approaches to curriculum have not yet informed the process of policy" (p.756). Yet you expect us, as Darling-Hammond (1993) points out, "to change our beliefs, understanding and actions as a result of a change process that consists primarily of an issuance of a statement on new curriculum initiatives that clearly cannot achieve the goals of reform" (p. 756).

Darling-Hammond (1993) also tells us that "not only is the kind of teaching required to achieve the goals of reform different from that required to achieve the goals of standardized testing, but the type of teaching that allows students to question, experience and explore ideas will require trade offs between breadth and depth of coverage" (p.756). She goes on to inform us that:

because government policy assumes that students are standardized and that educational treatments can be prescribed, it does not view teachers as needing expertise. Thus major teaching decisions are handed down through policy and encapsulated in packaged materials. It is better that teachers not be especially empowered because correct implementation relies on uniformity controlled from above. Therefore, there is little need and use for professional knowledge and judgment or for collegial consultation and planning (p.757).

The final irony is that your department seems to have dismissed the second part of the same research by Darling-Hammond (1993) that you rely on to guide your curriculum reform where she argues that "if we are to move to a new model of school reform, we must reframe the reform agenda by reducing prescriptions for practice while investing in new forms of professional, policy and political development. It is thus critical that policy makers approach teacher networks not from the standpoint of management and control but through agreements and

collegial relations” (p.759).

This collegial process must be in place to promote schools that focus on learners. No testing program can produce this type of accountability; it will occur only if we find ways to empower, encourage and support schools to reflect on their own sets of practices and focus on students and their needs rather than on the implementation of rules and procedures developed to maintain the privileged status of certain groups. You have congratulated us on the project’s ability to institute reform that benefits everyone. I hope that you will reframe your reform agenda to reflect the same type of inclusivity. In closing I cannot urge you strongly enough to rethink your reform package to include the views, needs and experiences of all people in this province.

TO RESEARCHERS

Theoretical recipes for changing the
classroom are many; examples are few.
(Bigelow et al, 1994)

One area of research that is experiencing a resurgence of interest is that of separate schools for girls. Many separate schools and classrooms are springing up across the country. Research by Perry (1995) and Durost (1996) found that young women flourish in all girls classes. Perry (1995) states that girls feel freer to speak out and achieve higher scores in all girls classes. Durost (1996) also found that girls achieve better marks in all girl classes and are also more likely to consider a career in math and science. However, as researchers we need to ask questions like: Are we allowing the existing school system to abdicate its responsibility to address gender inequities within its structures by providing special classes for a small number of girls? Do young women need special classes to improve their self esteem and academic achievement, or are they basing their choices on the reality that subjects like math and science as they are currently taught hold very little interest for them? We also have to question the ethics of encouraging young women in these areas without ensuring that there will also be institutional change to support them. Although I acknowledge the successes of all girls schools and classes, I believe if we focus our research questions on rethinking and transforming our existing educational structures to be more inclusive, young women will enrol and achieve of their own accord. As the results of our project indicated, young women are capable of achieving at high levels in the areas of math, science and technology within a

coeducational classroom.

One research area that is worth pursuing is whether the high scores and pass rates by our young women on the provincial math assessment were the result of them making appropriate choices. I sometimes wonder whether we need only to encourage more girls to enrol in math and science courses or whether boys also need to be counselled on making more realistic choices, based on their abilities rather than societal expectations for young men. It will be extremely important to pay particular attention to the educational reform movement towards outcome based education and standardized testing procedures to monitor whether our young women from girls only classes will continue to achieve on these types of assessments.

As a feminist it is important to be informed about the mainstream research and current trends in educational reform. One of the responsibilities of our research is to critique existing structures that impede the progress of women's struggle for equality. It is important that feminist thought continue to inform policy and research discussions. We need to do this first, to dispel some of the myths perpetuated about feminism and second, to provide another voice(s) to the discourse on changing schools.

We also need to understand and acknowledge where common ground exists between feminism and other more mainstream critiques so we can begin to build links with other researchers who are interested in educational reform. Erickson (1992) in his paper *Post-Everything: The Word of the Moment and How We Got Here* cites several examples where connections between feminism and poststructural theory can be made. Postmodern discussion by Rosaldo (1989) has common themes surrounding

the concept of multiple truths and the challenging of the idea of how knowledge is constructed within our society. The concept of multiple truths has helped me in making sense of the teachers' multiple realities about our school. The idea of multiple interpretations of reality can also be useful to argue against the government's belief that there is one set of knowledge that is worth learning and this can be constructed around one set of outcomes that are important for all students to know and be able to do.

As well as critiquing mainstream beliefs we also need continually to confront and question our own beliefs. Although I do not believe as liberal feminists might that levelling the playing field by simply eliminating the barriers is the answer to discrimination, I do acknowledge that without their work in identifying those barriers I would not be as far along in my own research. This project was carried out in an inner city multi-cultural school and so it was important to me to consider the issues of class and gender within our vision of inclusive education. At the time we expanded our project I had to ensure my beliefs about inclusive education included boys because I realized that many of our young men were also at risk because of issues of class, race and culture.

Another responsibility we have as researchers is to participate in field or action research. When we first initiated the gender inclusive project, there was a great deal of literature that theorized about girls' educational experiences but very few field studies being carried out in the schools to guide us through our process. One of the goals of feminist research is to initiate action that will lead to changing our present structures; it is therefore important for us to study the

process of change in action. If this work can be accomplished within a school setting, we have the opportunity to demonstrate that change can occur that will improve the lives of all of our students.

School culture is another area worthy of further study. Each organization or school will have its own culture influenced by the people who work there. An important question to consider is how can change be implemented within schools if the existing culture does not support it? There is a great deal of work that can be done by feminist as well as progressive researchers by becoming familiar with the values and beliefs embedded in the school and working to reshape that culture in new directions. Deal & Kennedy (1982) recommend that you start by examining the oral histories of the schools. They suggest you collect stories about the heroes and heroines of the school and identify what traditions or rituals are valued.

There are also many stories surrounding women's experiences in schools that need to be told. Just recently I had a visitor come to the school seeking information about our project. Initially, she indicated that she had read about our Roy C. Hill Fellowship award in the paper and was interested in researching our project for an assignment on innovative programs in the schools. As I talked with her I asked what high school she had attended as a student and she replied "this one". We then talked about her reasons for dropping out of school and she confessed it was because of a teacher. She described herself as a good student who had always done well until a negative experience with her math teacher at the school. She explained that she was made to feel ridiculed and stupid. She described walking to the door of that particular class every day and turning around and spending the period

hiding in the girls' washroom. She did this for forty days and then eventually stopped coming to school altogether. During the course of our conversation she became quite emotional about her experiences at the school and when I offered to take her to see some of the classrooms she replied "as long as it is not the same room as my math class. It's twenty years later and I still don't think I can go through that door." She also explained that she had a young daughter who would be coming to the school next year and part of her interest in doing her assignment on the school was to see if things had changed. At the end of our time together she also revealed that she had wanted to pursue the study of math and science at university and described it as "I wanted to be somebody". She left feeling relieved that her daughter's experience at the school could be quite different from her own. I tell this story because this woman has "become somebody". There are many other stories that need to be told and a large number of people who could be mobilized to advocate for school change based on their own experiences.

Taking on the role of story teller or change agent is a difficult and complex task. As the person initiating change, not only are you the change agent but also the lightning rod that fear of change chooses to strike. One of the strongest beliefs that some staff members at our school held is that anything associated with feminism must be evil. This view has changed little if any throughout the five years of the project. It did not matter that none of the actions we undertook were compulsory for staff or in any way interfered with their lives; there was an assumption that allowing a gender equity project in the school would destroy life as they knew it and I suspect, their sense of power. Resistance to change is based on many fears. Change for most people is

a very scary thought. When you also add a group's fear of losing their power, especially to women, you begin to understand what a person working on feminist change is up against. I believe it is this fear of women's power that feeds much of the resurgence of anti-feminist backlash.

Any person who undertakes a feminist change project must be prepared to deal with resistance to change on many levels. However, meaningful change will not occur if we don't have the courage to stand up and challenge the traditional structures that perpetuate inequality for women. When we started the gender inclusive project five years ago I understood intellectually that there would be resistance to the idea but emotionally, I was unprepared to deal with the hostility of some staff members who felt threatened by the presence of such a project. Before one takes on the role of implementing feminist change within our schools I would encourage you to ensure that the proper supports are in place. This might include the development of a network of supportive people both in your personal and professional life. Implementing feminist change will be full of struggles and contradictions, but it has its rewards as does any work you find personally meaningful. As you contemplate whether you might take on this work I would like to leave you with a line from the contemporary film "The Making of an American Quilt": "There are no rules to follow, you must trust your instincts and be brave".

CONCLUSION

At the start of this dissertation I stated that what essentially defines feminist educational thought is its emphasis on empowerment and social transformation. Many feminists work not for equal status in an unjust system but the transformation of that system. I have come to know, as has Wasley (1994), that teaching is not easily transformed, nor is the transformation process something that one completes. You never arrive as a teacher, because it is a journey of continuous learning and growth. Along our journey, the teachers in the pilot project and I have learned many things about our students, the nature of teaching and the organization of schools. I would like to conclude this work by highlighting some of those lessons learned.

We developed the gender inclusive project to address the disparity in participation, achievement and attitudes between young men and women in math, science and technology and chose to focus on teacher change. In this respect, we have been extremely successful, as evidenced by the outcomes of our attempts to connect with students. We have been less successful in spreading those changes throughout the school.

As I have already discussed in this work, there is a connection between our actions and our beliefs. When we initially started the gender inclusive project, we started with teachers who believed that this was in fact a legitimate issue and we have continued to add teachers who hold this belief. Teachers who have resisted this concept have their own set of beliefs; some are opposed to any issue involving equity, some do not believe inequity exists, some acknowledge it as an issue but do not believe it is their issue, some believe that they can

get away with discriminatory practices because their actions will be tolerated and some believe that it is not necessary for them to make any changes in their teaching practice regardless of the issue. The one thing that is common about all of these perceptions is that they are a reflection of our collective experiences and perceptions.

This leads me to comment about something I call the bubble theory. At the beginning of year four of our project we had a change in administration. The administrators met with small groups of staff to discuss issues of concern and ideas for the school. I attended all of those sessions to record comments into the computer so we could compile some common themes that the staff had identified. What was quite interesting to me was the range of realities that individual staff members presented. Some teachers would comment that the staff had never been informed about certain issues or opportunities and other teachers would say they had been told a hundred times. One teacher would identify an issue or a problem and another teacher would say it simply did not exist. After reflecting on this, I decided it was because we all have our own perception of reality based on our beliefs and experiences. It is as if we all exist within our own bubble. Information that fits our reality is allowed to pass through the bubble and be processed; information that we do not understand or believe is rejected and bounces off the bubble. Teachers assume they are acting under a common set of beliefs as teachers when in fact we often have very different beliefs and experiences.

Not only do we have different beliefs and experiences but we also use different voices. When I chose the title of this dissertation, "Voices from the other side of the room", I used voice as a metaphor for

the inclusion of young women in our classes. I have come to understand it is much more than that. We all speak in many voices, depending on our perceived place within an organization or relationship. People on the margins are often silenced or taught to speak in whispers, and schools are one of their first teachers.

The fact that we use many voices can lead to fragmentation, not only of ourselves, but in the messages that we send to people. We often hide our disagreements with colleagues behind a mask of contrived collegiality because we understand that using the voice of courage and conviction often leads to conflict. Little (1993) argues that conflict is a natural byproduct when schools seriously begin examining their purpose. Little also tells us this is to be expected as these conversations touch on the values, knowledge and purpose of schools. Although tension and conflict will always be present in the process of change, we must begin to look at ways of encouraging open discussion and handling dissent. This was one of the most difficult issues for our school and which for one we have not yet found a solution.

Fragmentation and contrived relationships exist on many levels within a school. Teachers are often divided into departments and isolated from each other, subject material is seldom related to any other discipline, rarely do we explain real world applications to our students and teachers maintain relationships of distance and authority from their students. Although it was the young women in our project who taught us the importance of establishing connections and supportive classrooms, we have come to understand that these connections are important to all of our students, especially those who have not seen their lives as part of their educational experience. We also came to

know that a safe supportive environment for teachers is critical for them to take on the risks of changing their teaching practices. The teachers in the pilot project have talked about the importance of the support and trust of the other group members to sustain their personal change efforts.

Schools traditionally have been organized on hierarchal principles of power and control. Leithwood (1992) cites evidence that claims that "the blame for the predictable failure of educational reform rests, in a large measure, on existing power relationships in schools" (p.8). Lieberman (1995) argues that administrators need to understand that power and control are obstacles to trust and risk taking. Instead, administrators must focus their attention on using facilitative power to support change in their schools. Facilitative power requires the understanding of the necessity of support, shared vision making and at times gentle pressure to assist teachers in changing their instructional practices. Administrators must also be supported and given the freedom to transform the structures of their school that impede that transformative process.

One of the most common barriers to change is the lack of teacher time. It is not realistic to assume there will be significant teacher change unless they are provided with the time to reflect on their practice. The teachers in the pilot project identified that the time to meet, discuss, reflect and meet again was paramount to the success that they had in their classrooms. The provision of teacher time and other reforms can be justified if we ensure those reforms are linked to student learning. If we are to undertake serious transformation of our schools we must understand why we are doing it and the why is more

important than the how. This has been one of the most important things we have learned in our project. We never stated that we found the magic answer to include young women in math, science and technology, but instead focused on why we needed to implement inclusive strategies within our classrooms. We engaged in a continual process of examination, reflection, learning and action, keeping our students at the center of our teaching practice. In return, we have been rewarded with classrooms where students are more engaged and excited about their learning, because teachers created an environment for success.

In some ways I feel I have come full circle in my work. When I finished my master's thesis on the barriers for women in attaining leadership positions I was convinced that the answer was not in affirmative action programs, law or politics, but in educating young people in a more inclusive environment so both genders could come to appreciate the values that have been traditionally associated with women. At the end of this work I have come to appreciate that we must find many answers and approaches to this problem.

The teachers in the gender inclusive project discovered that they can improve their teaching strategies, classroom environment and student performance. We also found that unless more traditional procedures, policies and roles also change, teachers will be severely restricted in their efforts to spread their accomplishments throughout the system. Implementing any kind of change in a school is a political process.Sizer (1992) argues that "everybody needs to change their role, that no school personnel will be untouched once change is underway" (p.207). His point was that teaching students to use their minds and become involved in their education requires everyone to to work in different

ways (Wasley, 1994). Our participation in the gender inclusive project taught us that we must become a community of learners: students, teachers, administrators, policy makers and professors, continually acting, reflecting and sharing what we have learned about the teaching and learning process within a supportive environment. If we can do this, we can begin to learn together how to make schools a better place for our students.

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APPENDIX ONE

INTERVIEW QUESTIONS

1. WHAT MATH, SCIENCE, COMPUTER SCIENCE CLASSE(S) ARE YOU ENROLLED IN?
2. DO YOU LIKE/DISLIKE THESE CLASSES?
3. CAN YOU TELL ME WHAT IT IS YOU LIKE/DISLIKE ABOUT THESE CLASSES?
4. WHAT DO YOU CONSIDER TO BE THE MOST IMPORTANT FACTORS FOR STUDENTS TO ENJOY AND /OR DO WELL IN THESE SUBJECTS?
5. HOW WELL DO YOU DO IN THESE SUBJECTS?
6. DO YOU PLAN ON CONTINUING IN THE MATH, SCIENCE COMPUTER AREA? WHY OR WHY NOT?
7. WHAT DO YOU WANT TO DO WHEN YOU GRADUATE?
8. WHAT DO YOU EXPECT TO DO WHEN YOU GRADUATE?
9. WHAT KINDS OF THINGS DO YOU ENJOY ABOUT SCHOOL?
10. WHAT KINDS OF THINGS DON'T YOU ENJOY ABOUT SCHOOL?
11. ARE YOU COMFORTABLE SPEAKING OUT IN CLASS? WHY? WHY NOT?

13. DO YOU THINK BOYS ARE NATURALLY BETTER THAN GIRLS IN THE AREA OF MATH SCIENCE OR COMPUTERS? WHY? OR WHY NOT?

14. HOW IMPORTANT DO YOU THINK MATH, SCIENCE AND COMPUTERS ARE TO YOUR FUTURE?

15. WHAT KINDS OF THINGS WOULD YOU CHANGE ABOUT YOUR MATH, SCIENCE COMPUTER CLASS IF YOU COULD?

16. ARE THERE ANY QUESTIONS YOU WANT TO ASK OR COMMENTS YOU WANT TO MAKE?

APPENDIX TWO

STUDENT INTERVIEWS

INSTRUCTIONS TO BE READ TO INTERVIEWEES: Your teacher and I are very interested in students' attitudes towards math, science and computer technology and how they are taught at this school. I will be asking you some questions about these topics. We are not looking for right answers but are sincerely interested in what students think and feel. If at any time you are not comfortable answering a question or feel you don't have an answer tell me and we will move on. Would it be alright if I taped the interview? It is easier for me to listen to your answers if I don't have to write at the same time? No one will listen to the tape but myself and your answers will be included with other student responses to ensure your confidentiality. At the end of the study these tapes will be destroyed. The tape recorder will be placed beside you and you may turn it off at any time. Thanks.

INSTRUCTIONS TO THE STUDENT AT THE END OF THE INTERVIEW: Thank you for participating in this interview. The information you have provided will be extremely helpful to both myself and your teacher. When all the results have been compiled I will come back to class to discuss them with you and provide a written copy to those of you or your parents who requested them. If you think of anything else that you would like to add or delete at a later date or wish to discuss this topic further please come and see me anytime. Once again, thank you for your cooperation and help.

APPENDIX THREE

QUESTION AND ANSWER BOX ASSIGNMENTS

In order to help you learn better, to become aware of your strengths in Math and to help me to understand them better, you are asked to contribute to the 'Question and Answer Box' **once every two weeks**.

This contribution is a written report of at least **two paragraphs**:

1. a paragraph **about yourself**. You could tell me about yourself, your family, your math history, your goals, your reason(s) for taking this course, your intentions following high school, your career interests, etc..

I'll suggest a topic for you for each assignment.

2. a paragraph **about some aspect of YOUR work in Math**—something that you find (found) particularly satisfying, challenging, puzzling, surprising, enlightening, discouraging, mystifying, or unintelligible in **THIS MATH COURSE**.

You can deal with the successes (and failures) of **YOUR** doing your Math assignments, your daily studying, organizing your notebook, your study habits, sample problems in your text, correcting and identifying your errors, preparing for a test, or any other aspect of **THIS** Math course.

Your contribution can be either a **QUESTION** about something you have not yet managed to learn, or an **ANSWER** to some difficulty that you had but have overcome in the meantime. In either case, you have to be **SPECIFIC**.

Suppose, for example, that you have a textbook exercise that states:

Calculate: $-3^2 - |-2 - 5| + 3(-3 + 1)^2$

It's not much use to say "I don't understand how to do it." as your contribution. Instead, you could explain that you tried the problem, but you could not get the correct answer. Then, you could:

- ♦ show different methods you had tried
- ♦ what you understand to be the meaning of the symbol $|x|$ or
- ♦ the concept of squaring with and without a brace

It is important to be SPECIFIC.

The contribution should be about **a page long** and should be handed in **every second Friday**. Please put your name on the paper so that I know who is writing. Since it is the **INFORMATION** that I need from you, I will read the paper, but not 'mark' them in the usual sense. The very fact that you regularly make contributions will earn you five marks towards your term mark.

I will use a selection of contributions in class (without using any names) to illustrate some of the problems that people have solved or are still facing, and help others with similar concerns to master them. I will write back to you and answer any questions you may have about this course or answer any concerns you may have about this course or any other topic in your personal paragraph.

I LOOK FORWARD TO READING YOUR CONTRIBUTIONS!

ADAPTED FROM: F. DAVIS, A. STEIGER. UNIV. COLLEGE, MONTREAL

APPENDIX FOUR

PHYSICS/CHEMISTRY PORTFOLIO AND JOURNAL ASSESSMENT

Portfolio and journal entries should be systematic, purposeful and meaningful collections. They should reflect the day-to-day learning activities. A variety of media should be incorporated with the collection being multidimensional.

Various strategies I have used:

- self-assessment checklist
- self-assessment statements
- attitude survey
- worksheet pages, quizzes & tests
- collaborative works
- interviews
- journal entries
- newspaper articles; reports; model construction
- teacher checklists
- teacher comments
- concept maps
- defense arguments (ie., take a stand and defend it)
- timelines
- computer simulations
- students' questions that lead the student to research the answer

The evaluation has been done in a rubric manner. On a scale of 0 -3, portfolio items are assessed and commented on. Journal entries are not graded as such. They are checked off as being completed.

MATH PORTFOLIO

MATH IN THE CLASSROOM	MATH OUTSIDE THE CLASSROOM	SELF EVALUATION
test, quiz, assignment, group assignment selection	sample of math used in another subject area	attendance, attitude, effort
error identification - correction	individual math history	goals - for the following term or for the following year
explanation of a problem	incorporation of other languages	things I would have changed
show more than one way to solve a selected problem	collection of data to solve a problem (using the library)	the most important thing I learned
selection of one question from each major topic covered	graph or chart from newspaper	the best topic, the worst topic
identification of skills required to solve a problem	math errors found in the community	working with others
description of study skills used	math on the job - interview	the best way I learn
description of weaknesses and strengths in selected topics		