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ABSTRACT

Narrative accounts construct and reconstruct stories of school experiences in order to make meaning of them. This document reports the results of narrative inquiry in the mathematics experiences of 7 women and 15 eighth-grade girls in an effort to determine why women and girls avoid mathematics. Memories and reflections were gathered using narrative-based tools, such as letters and stories, and interviews. This data was examined for underlying themes and images relative to the research question. Four themes emerged from the analysis: (1) the influence of teachers' behaviors on students (teachers who made students feel special, cared for, honored and liked, were remembered fondly); (2) the influence of parents' behavior (their support or lack of support) on students' (wish to do well to please parents); (3) personal decisions regarding attitudes toward mathematics; and (4) attitudes of boys toward girls. Results indicated that teachers were the focus of the stories told by the participants. Participants recounted how teachers affected the way the participants felt in the mathematics classroom and how teachers who made connections to real life situations were the best teachers. Participants expressed frustration in dealing with help from their parents. Results suggest that having students tell the stories of their experiences may need to be an integral part of the classroom environment and curriculum. (Contains 68 references.) (MDH)

MATHEMATICS EXPERIENCES OF WOMEN AND GIRLS: A NARRATIVE INQUIRY

by

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ABSTRACT

This project is a narrative inquiry into the mathematics experiences of seven women and fifteen grade eight girls. It includes a review of the literature concerned with women, girls and mathematics, writing in the mathematics classroom to give students "voice", and narrative inquiry. The narrative account constructs and reconstructs stories of school experiences in order to attempt to make meaning of them. Memories and reflections are gathered using narrative-based tools, such as letters and stories (Connelly and Clandinin, 1988), and interviews (Mishler, 1991). These tools help to uncover personal knowledge of mathematical abilities.

The stories are examined for underlying themes and images. Some of the themes that surfaced are easy to identify, such as teachers and parents. Others are more difficult to uncover, such as personal decisions and boys.

All teachers need to be aware of these issues. Women of all ages, who feel unable to "do" mathematics, need to tell their stories in order to begin a transformation of the world around them.

ACKNOWLEDGEMENTS

The stories that are told in this project are only a few of the many that have been shared with me by students, friends, colleagues, and family. I would like to thank all of the women and girls who told their stories so willingly.

I would particularly like to thank three of my friends who are described in this report. These women kindly fit this inquiry into their busy lives. My sincerest thanks to each of them. (All of the names used in this paper are pseudonyms.)

Dr. Rena Upitis introduced me to the narrative method of research and for that I am very thankful. I would also like to thank her for her thoughtful comments on this paper.

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CHAPTER 1

INTRODUCTION

1.1 My Narrative

In the fall of 1988 I attended a workshop at the Ottawa Board of Education as an interested observer and a community college teacher of mathematics and science. The purpose of the workshop was to address the question "Why are there not more girls taking senior level mathematics and science courses?". I was shocked to hear that the statistics had not changed at all since I had attended high school in Ottawa, fifteen years previously. A number of female students were present, and they told their stories of being one of only three or four girls in each of the grade thirteen mathematics and science classes. I was sure that in all of that time the number of girls choosing these subjects would have increased. I was wrong.

As an adult education teacher I often hear comments such as: "I feel sorry for you! You have to teach ME math", "I'm

terrible at multiplying", and "I can't work with numbers". These comments come more often from women than from men. I have encountered many women who wanted or needed to learn mathematics but they had to come to see themselves differently in order to meet their goals. They had to begin to see themselves as able to "do" mathematics.

Many of the students who enter adult education classrooms in order to upgrade their mathematics skills have been out of school for ten to twenty-five years. Some left school at an early age after experiencing successive failures; others were forced to leave school early to find work. For those with unhappy school experiences, their feelings about returning to a school situation are mixed. They are motivated to upgrade their skills to improve their job prospects, but the thought of experiencing failure again is frightening.

Often these students feel troubled and uneasy about mathematics. From my experience, women express these feelings more often than men, even though there do not seem to be any differences in their abilities.

I chose a full program of mathematics and science courses when attending secondary school and was able to manoeuvre through the system quite successfully. I grew up in an environment of constant encouragement to do my very best and was told that I could be anything I wanted to be when I grew up. It never occurred to me that I could not be a scientist or

a mathematician. This encouragement went along with a school experience that was positive and supportive enough to allow me to progress. However, one of my sisters and many of my female classmates, who also had supportive home environments, did not feel comfortable with the subjects of mathematics and science.

Simply telling girls that they can be anything they want to be when they grow up does not seem to be enough to motivate them to freely choose mathematics and science classes, or to feel comfortable in these courses. I have experienced the surprised looks on people's faces when I say that I have a chemistry degree or that I teach physics or mathematics. Often the reaction does not stop with a look, but continues with comments such as "Really!" or "You're not serious!".

My attempt to help my students alleviate their anxiety and encourage them to progress toward their goals began by trying to understand the origin of these anxieties. I know that when a women steps through the door of an adult education classroom she has taken a very large step. She has decided that she is ready to tackle the task of learning mathematical concepts. She needs considerable support to encourage her to understand that previous painful experiences may not be due to personal failure. She needs to talk to other women to realize that she is not alone and like most women is quite able to think mathematically. She needs to talk openly with women who have avoided mathematics, women who have succeeded

at mathematics, and women who have failed at mathematics. These stories need to be told for her to begin a transformation in the understanding of the world around her.

1.2 Focus of This Inquiry

Why do so many women and girls avoid mathematics? What can be learned from reflection on the narratives of our early school experiences?

This collaboration consists of two parts. The first part involves a group of women who wrote letters and stories of their early school experiences to me, and I wrote back to them in response. Some of these women then met to share their stories with each other. The second part of this study involves a group of grade eight girls who share their stories of early school experiences, and their ideas and feelings about mathematics.

1.3 Literature Review

Women, Girls and Mathematics

Over the past two decades there have been many changes in our schools as a result of the evolution of feminist thinking. Damarin (1990) points out various changes in athletic departments, extracurricular activities, the courses of study

for English and history, and the examination of our textbooks and teaching materials for "sexist bias". She stat s:

> Within the area of mathematics, increased research on women and mathematics, including work on attitudes toward mathematics and the role of course taking on mathematical achievement, has led to some changes in the mathematical experiences of girls and young women. (p.144)

She feels that although the changes made to date have often been controversial and even painful for some, these changes have been the easiest and most obvious changes, and that there is the need for further change in the teaching of mathematics.

Allen (1991) suggests that the mathematics presented in schools and the way in which this mathematics is presented are "female unfriendly". He summarizes the most common reasons found in the literature to account for the absence of women in mathematics:

> (i) the supposed short-comings of women, (ii) observed statistically significant differences between the performances of boys and girls in solving mathematics problems, (iii) the differential treatment of girls and boys in classrooms, and (iv) the general problems of women in society. (p.1)

Research on the supposed short-comings of women suggests that something in their nature limits their success at mathematics. An example of this type of research would be those studies suggesting that women's "deficient" spatial ability results in their lack of success in mathematics or in certain types of mathematical activity.[1] Gold (1990) points out that in the

past we have erroneously tried to "fix" the girls, and that this approach did not work. Locating the problem within girls and women is another instance of blaming the victim - an approach justly and effectively criticized by feminists and indeed by most sensitive thinkers (Allen, 1991, p.1).

Damarin (1990) discusses sex differences and mathematics ability and states: "The general trend of research findings provides increasing evidence that sex differences in overall mathematical ability are negligible or nonexistent" (p.147). The disturbing aspects for young women are that these findings have not been widely publicized and that the question continues to be asked. She states that the failure to recognize a student's anxiety about whether women are mathematically inferior is to deny an important part of the mathematical reality of the student. Damarin (1990) concludes by saying that "a major objective of mathematics instruction must be that all students learn that they can learn mathematics" (p.150).

Benbow and Stanley's (1980) research findings were based on statistically significant differences in mathematical test results. They assumed that boys and girls who have taken the same number of years of mathematics education have had the same mathematical experiences. Studies such as these are problematic in at least two ways. First, researchers such as Spender (1982) and Walkerdine (1989) have conclusively shown

that boys and girls in the same classroom have very different experiences. This would tend to refute the first assumption. Second, as Allen (1991) points out, statistical analysis of the differences in performance between girls and boys may tell us where to look, but it cannot tell us why differences in performance are observed. He continues: "Statistical analyses of this type tend to deal in generalities and result in trivialities in the sense that statistically significant differences are not necessarily of practical significance" (p.1). Girls and women who are attempting to be successful in mathematics classrooms are not assisted by information about such differences. This kind of information tends to contribute to the anxiety that some women and girls have about whether they are mathematically inferior.

Allen (1991) discusses two interesting pieces of information that statistics provide: girls who stay on in mathematics do at least as well as boys, and in spite of this, the fraction of girls entering mathematics competitions or choosing careers as mathematicians is very small.

The National Research Council's report on the future of mathematics education entitled Everybody Counts (1989) states that: "Gender differences in mathematics are predominantly due to the accumulated effects of sex-role stereotypes in family, school, and society." (p.23). Allen (1991) believes that this statement omits the nature of mathematics and mathematics

instruction. It also leaves out whether the way mathematics is taught would appeal to most women.

Sylvia Gold (1990) believes that we should "fix" the way we teach mathematics, instead of trying to "fix" the student. Feminist thinkers (Damarin,1990; Walkerdine, 1989; Gold, 1990; Spender, 1982) remind us that our society - including our schools, our curricula, our teaching methods, and the subject of mathematics - was created primarily by men and reflects the life experiences and goals of men.

Damarin (1990) suggests that on recognizing that mathematics has masculine historical roots, it is appropriate to examine instructional practice for evidence of the "gendering" of the subject. One aspect to be examined is the language of mathematics. This author points out that the vocabulary of mathematics contains many aggressive words and as a first step we should consider using terms that promote a more cooperative approach to realistic problems.

> As a first step we might think about, and discuss, what it would mean if instead of working toward students' mastery of facts and concepts, we worked toward students' internalization of them. Instead of leading students to attack problems, why not interact with them? We might share problems and work cooperatively toward their solution. Rather than torpedoing misconceptions, we might share the lack of fit between two ideas, making of it a problem for cooperative resolution. (p.146)

The National Council of Teachers of Mathematics (NCTM) (1989), in a document entitled Curriculum and Evaluation

Standards for School Mathematics, challenge educators to change current practice. The document states that if students are exposed to the kinds of experiences outlined, they will gain mathematical power. Damarin (1990) might suggest that mathematical empowerment is a more "friendly" goal. There is agreement in the literature (Higginson, 1980; Damarin, 1990; Bishop, 1990) that language is important, therefore it is necessary to consider how the development of language is connected to the consciousness of mathematics ability.

Girls may see themselves as excluded from mathematics because they understand mathematical power as male. Young women may choose not to "gain mathematical power" (NCTM, 1989,p.5) if they perceive this to be unfeminine.

The Girls and Mathematics Unit of the University of London Institute of Education has, over a period of ten years, carried out detailed observations and theoretical investigations in the area of girls' attainment in mathematics (Walkerdine, 1989). This research involved a group of thirty girls from the age of four (when they were at home with their mothers) until their fourth year of secondary school. The group included girls from working and middle class families.

Walkerdine (1989) observed anxiety in the girls at the middle class schools. Even though the girls performed well, they constantly felt and were told that they were not good enough. Walkerdine concludes: "They often tried to be nice,

kind, helpful and attractive: precisely the characteristics that teachers publicly hold up as good - asking all children to work quietly or neatly, for example, while privately accusing the girls of doing precisely these things" (p.203). In fact, even in the fourth year of secondary school, girls were still performing better overall than boys, but were described by the teachers as "unconfident", and were not pushed or helped. Furthermore, these girls were not entered into prestigious examinations in the same numbers as boys. It is clear from feminist research (Fox Keller, 1985; Weedon, 1987; Walkerdine, 1989) that few girls achieve femininity and intellectual excellence in mathematics and science.[3]

Weedon (1987) describes subjectivity as: "the conscious and unconscious thoughts and emotions of the individual, her sense of herself and her ways of understanding her relation to the world" (p.32). She goes on to say that subjectivity is the product of the society and culture within which we live.

The involvement of language in the development of subjectivity is very important. Weedon (1987) points out that language is the place where our sense of ourselves, our subjectivity, is constructed. "As we acquire language, we learn to give voice - meaning - to our experience and to understand it according to particular ways of thinking, particular discourses which pre-date our entry into language" (p.33).

Weedon (1987) defines language in the following way: "Language is not the expression of unique individuality; it constructs the individual's subjectivity in ways which are socially specific" (p.21). She states that meaning is produced within language rather than reflected by language.

Not only does language give meaning to the world, but it also defines who we are and who we might become. Weedon (1987) proposes that the development of subjectivity is a process that includes disunity and conflict. Little girls experience disunity and conflict in the areas of mathematics and science when they first receive the message that these subjects are not feminine. Some girls are not affected by these messages enough to cause them to avoid these subjects, or they might have access to counter discourses that oppose these messages.[4] Other girls are severely affected by these messages and choose to avoid these classes.

Within her discussion of language and subjectivity, Chris Weedon (1987) states: "The power of experience in the constitution of the individual as social agent comes from the dominant assumption in our society that experience gives access to truth" (p.80). She also says there is little question of experience being open to contradictory interpretations guaranteed by social interests rather than by objective truth. It is this process of discussion of experiences and the realization that there might be different

explanations that is necessary to open the field of mathematics to girls. For example, many women have rationalized their painful experiences as young girls in the mathematics classroom as due to a lack of ability. Very often family and friends contributed to this interpretation. In fact, these experiences may have been due to a socially produced conflict.

In the last ten years researchers such as Gilligan (1982) and Belenky, Clinchy, Goldberger, and Tarule (1986) have identified "ways of knowing" that are primarily, although not exclusively, feminine. Belenky et al (1986) state:

> We have argued in this book that educators can help women develop their own authentic voices if they emphasize connection over separation, understanding and acceptance over assessment, and collaboration over debate; if they accord respect to and allow time for the knowledge that emerges from firsthand experience; if instead of imposing their own expectations and arbitrary requirements, they encourage students to evolve their own patterns of work based on the problems they are pursuing. These are the lessons we have learned in listening to women's voices. (p.229)

Allen (1991) asks his readers to consider the mathematics classrooms that they are familiar with and to reflect upon what goes on there. He asks the question: "Are mathematics classrooms inviting to females given what we know about their preferred ways of coming to knowledge?" (p.5). By allowing learners to write, re-write, and share their stories, educators will give "voice" to those students who have been

silent.

Giving Students Voice

Stempien and Borasi (1985) discuss the importance of students' writing in mathematics. They propose that writing could be considered as a "powerful learning tool" (p.14). These authors suggest various examples that might be considered, with regard to the content addressed, such as feelings and attitudes towards mathematics. They give as examples of format: stories, diaries, anecdotes and dialogues. They state:

> Giving the opportunity to express such elements of the writer's experience with mathematics could also turn out to be important for example in helping to overcome some fears and blocks toward the learning of the subject. (p.15)

Feelings and beliefs about mathematics generally have a strong influence upon our approach to the discipline and can even lead to misconceptions or hinder understanding and learning. Stempien and Borasi (1985) suggest that in school we should recognize the importance of these emotional reactions and help students to become aware of them. Writing provides a non-threatening format for shy or emotional people who might feel uncomfortable in an interview or in a class discussion. These authors show the possibility of engaging students in a variety of writing activities on mathematics related content and they propose that involving students in different writing

experiences could contribute in a complementary way to their learning of mathematics.

According to Stempien and Borasi (1985), Feldman (1983) gave remedial college students the task of writing an anecdote about individual past experiences with mathematics and this proved to be a device that helped some students to realize the origin or cause of their math anxiety and constituted the first step in trying to overcome it.

Buerk (1982) spoke to many mature women who avoid mathematics or feel apprehensive about it. They believed that if they were good at mathematics then they should be very quick and competitive with it. If they were not, then they felt inadequate and powerless against what one stated was "the wicked mathematician who has all the answers in the back of the book" (p.19).

The women that Buerk (1982) worked with viewed mathematical knowledge as dualistic and all other knowledge as relativistic. Using Perry's (1970, 1981) definition of the term dualistic, she quotes:

> He defines dualism as: Division of meaning into two realms - Good versus Bad, Right versus Wrong, We versus They. All that is not Success is Failure, and the like. Right Answers exist somewhere for every problem, and authorities know them. Right Answers are to be memorized by hard work. Knowledge is quantitative. Agency is experienced as "out there" in Authority, test scores, the Right Job. (Perry, 1981,p.79) (p.19)

In contrast to dualism, the women in Buerk's (1982) study

viewed other kinds of knowledge as relative and contextual. This discrepancy concerned Buerk (1982), and her study examined whether these women could be helped to see mathematics from a perspective more closely aligned with their view of the world in general.

Buerk (1982) found, from her experience, that a more relativistic view of mathematics, coupled with a sense of personal responsibility for their own learning, made mathematics more approachable for the women in her study. In the summary of her paper, Buerk (1982) states: "There is much we can learn from listening to the way our students view mathematics as a field of knowledge" (p.24). She also feels that examining apprehension about mathematics from the perspective of a developmental scheme like Perry's provides an alternative not usually present in work with people who avoid mathematics.

Mathematics educators need to listen to the stories of their students. They need to provide opportunities for all students, even those who are traditionally silent in the mathematics classroom, to tell their stories. In this way, students will be given "voice" and be allowed to participate in mathematics with a new understanding of their role in the community of the classroom. Connelly and Clandinin (1990) quote Britzman (1991), who wrote:

The struggle for voice begins when a person

> attempts to communicate meaning to someone else. Finding the words, speaking for oneself, and feeling heard by others are all a part of this process....Voice suggests relationships: the individual's relationship to the meaning of her/his experience and hence, to language, and the individual's relationship to the other, since understanding is a social process. (p.4)

Narrative Inquiry

A search of the literature revealed that there has not been very much published research in the area of mathematics education and narrative inquiry. Connelly and Clandinin (1986, 1988, 1989, 1990) are by far the most prolific authors in the field of teacher education and narrative inquiry, therefore this review will be based primarily on their work.

Narrative inquiry has been used in many academic fields such as literary theory, history, anthropology, drama, art, film, theology, philosophy, psychology, linguistics, aspects of evolutionary biological science and increasingly in studies of educational experience (Connelly and Clandinin, 1990).[5] Connelly and Clandinin (1990) explain that "the main claim for the use of narrative in educational research is that humans are storytelling organisms who individually and socially, lead storied lives" (p.2). According to Polkinghorne (1988), narrative is "the primary form by which human experience is made meaningful" (p.1).

Clandinin (1988) relates the narrative research approach

to feminist research in three ways: the research methodologies, the task of giving teachers voice, and the attention given to distinguishing connected and separate knowing.[6] Connelly and Clandinin (1988), in their book Teachers as Curriculum Planners: Narratives of Experience, redefine the nature of curriculum in a way that brings personal experience to life.

The idea of "personal knowledge" goes at least as far back as the work of Polanyi (1958), who examined the nature and justification of scientific knowledge. He describes the term "personal knowledge" as a fusion of the personal and the objective. He states:

> Such is the personal participation of the knower in all acts of understanding. But this does not make our understanding subjective. Comprehension is neither an arbitrary act nor a passive experience, but a responsible act claiming universal validity. Such knowing is indeed objective in the sense of establishing contact with hidden reality; a contact that is defined as the condition for anticipating an indeterminate range of yet unknown (and perhaps yet inconceivable) true implications. (p.vii)

Connelly and Clandinin (1988) agree that narrative inquiry produces a result which is at odds with the idea of objective knowledge.

The relationship between practice and theory have been of interest to Connelly and Clandinin (1988) (along with Schon, 1983; Schwab, 1970, 1971, 1973, 1983; and Elbaz, 1983) They believe that one does not apply theory to practice but,

instead, one works with practitioners (in their case teachers) to better understand practice and to enhance its ongoing practicality. "Practice is theory in action" (Connelly & Clandinin,1988,p.95). These authors take Polanyi's idea one step further by developing the concept of "personal practical knowledge".

Connelly and Clandinin (1988) show, in their work with teachers, how reflection on their narratives of experience helps them make meaning of their lives as teachers. They also talk about the realization that each of us, not only teachers, keeps telling and retelling stories about our past. "And in the telling of our stories we work out new ways of acting in the future" (p.xvi).

It seems clear that learners should be able to participate in the reflection of their narratives of experience in order to help them to make meaning of their lives. Spender (1982) points out: "If talking about one's own experience is essential to learning then it must be stated that girls have very reduced opportunities in mixed-sex classrooms - both because of the restrictions placed on their talk and the restrictions placed on their experience" (p.60).

Teachers of mathematics need to be aware of these restrictions that have been placed on their female students in order to come to understand some of their anxieties. There must be opportunities in the classroom for the students'

stories to be told. This may seem to be common sense, but indeed many students have never been asked to tell their stories.

The process of narrative inquiry allows both the researcher and the participants to collaborate in the research. Hogan highlighted several important issues in the research relationship: the equality between participants, the caring situation, and the feelings of connectedness (Connelly & Clandinin, 1990,p.4). These authors see the negotiation of entry into the research field situation as a negotiation of a shared narrative unity. They also suggest that this is collaborative research which requires a close relationship akin to friendship. "An interpenetration of two or more persons' spheres of experience." (p.4).

Connelly and Clandinin (1988) propose a number of "tools of reflection" which are useful in thinking back and coming to understand one's self. Storytelling, letter writing, interviews, and participant observation are some of the methods described for use when working with other people.

Bateson's (1990) book Composing a Life is an example of an intricately written narrative of the lives of five women. She talks of life as an "improvisatory art" (p.3) and her own life as a "sort of desperate improvisation in which I was constantly trying to make something coherent from conflicting elements to fit rapidly changing settings" (p.3). She goes on

to say: "Storytelling is fundamental to the human search for meaning, whether we tell tales of the creation of the earth or of our own early choices." (p.34).

> Women today read and write biographies to gain perspective on their own lives. Each reading provokes a dialogue of comparison and recognition, a process of memory and articulation that makes one's own experience available as a lens of empathy. We gain even more from comparing notes and trying to understand the choices of our friends. When one has matured surrounded by implicit disparagement, the undiscovered self is an unexpected resource. Self-knowledge is empowering.(Bateson, 1990, p.5)

Bateson (1990) is careful to point out that these are not representative lives - they do not represent a statistical sample. She explains that what interests her the most are the "echoes from one life to another, the recurrent common themes" (p.16). "Teasing these out of a wealth of material and conversation and recognizing aspects of my own experience in different forms has been the process that I found personally most freeing and illuminating." (p.16).

Narrative, like other qualitative methods, relies on criteria other than validity, reliability, and generalizability. Connelly and Clandinin (1990) point out various criteria that should apply, but stress that each inquirer must search for, and defend, the criteria that best applies to his or her work. "It is a helpful reminder to those who pursue narrative studies that they need to be prepared to follow their nose and, after the fact, reconstruct their

narrative of inquiry." (p.7). Among others, they have identified verisimilitude (the truthfulness of the account) and transferability (how well others can relate to the narrative) as possible criteria for assessing the quality of the narrative.

Narrative inquiry is a powerful method of research in the study of women and mathematics experiences. Reflection on the narratives of early school experiences may help women who see themselves as unable to "do" mathematics, to see themselves differently. The curriculum of mathematics must be examined for the "gendering" of the subject. Mathematics classrooms must also be examined for their "female-friendliness". Teachers and students who are given the opportunity to tell their stories, using any of the various tools mentioned above, are given "voice". They then begin the journey of coming to understand their past experiences, the experiences of others, and their role in the mathematics classroom in a different light.

Chapter 2

METHOD

2.1 The Participants

The first part of this study involved a group of seven women to whom I wrote letters and stories, and who wrote letters and stories back to me. I was well acquainted with all of these women prior to the initial correspondence. One of the reasons for choosing these women was that I hoped that our friendship would allow those memories and stories to be shared more easily.

The age range of these women is from early twenties to late fifties. The range of feelings about mathematics are as varied as the ages: some feel quite comfortable with the subject and others feel that either they are unable to "do" mathematics or that they "hate" mathematics. All of these women have a university degree or are currently participating in post-secondary education, and two of these women have post-graduate degrees.

I have chosen three of these women as the centre of this study for two reasons. First, Connelly and Clandinin (1988) state that three stories written by each person seems to be a minimum number to examine for themes, threads or patterns. Each of these three women wrote enough material to be able to search for themes. Second, each of these women have different feelings about mathematics.

The second part of this study involved a group of fifteen grade eight girls who volunteered to share their feelings about mathematics. I had never met most of these students before, but they attend school in my neighbourhood and since I volunteer there, most of them had seen me around the school.

2.2 Letter and Story Writing

In the early fall of 1991 I wrote letters to seven women asking them if they would participate in this study. I told them that I was interested in any memories that they had of early school experiences, with a particular emphasis on mathematics experiences. I suggested to them that they start with a story of their earliest memory of school. Connelly and Clandinin (1990) point out that trying to write a chronology first seems to be an easier task than asking people to write a narrative.[7]

After I received a letter from one of these women, I promptly wrote back questioning her about aspects of the letter or asking her to write a story about a person she had mentioned or an incident she had briefly described. I also sent each of the participants stories that I had written. Some of the women were only able to write once, others wrote back many times.

At the end of December, 1991, I was able to meet with three of these women to read our stories to each other and discuss them. I taped and transcribed this discussion.

2.3 Interview

On March 5, 1992 I met with a group of fifteen grade eight girls (all of the grade eight girls that were present that day) to introduce myself and to invite them to come to a session to talk about how they feel about mathematics. I gave them a letter (with a parental permission slip attached) (Appendix A) and indicated that only students who wanted to come should attend. Every girl that came to the meeting participated in the discussions.

During the last week of March, 1992, I met twice with a group of fifteen girls in their classroom. There were no boys present. I interviewed them in the context of an interview described by Mishler (1991) in his book Research Interviewing:

Context and Narrative. Mishler believes that the "story" is a joint production because of how the interviewer listens, attends, encourages, digresses, initiates topics and terminates responses.

The format of this interview more closely resembled a casual discussion. I had prepared some general questions such as: What is your earliest memory of school? How do you feel about mathematics? Can you recall a "really good" math teacher? Do you consider yourself a problem solver? The students guided the direction of the discussion most of the time. I taped and transcribed the discussions.

2.4 My Role

During the course of this study I have a number of roles. I am a participant as I write letters and stories to share with other participants, and as I develop this narrative. I am also a researcher as I reflect on the stories, letters and interviews and look for themes or common threads. At the same time, I am a narrative critic attempting to assess whether or not this method of inquiry is appropriate for contributing to our knowledge about mathematics and the ways people learn this subject. I also wear many other hats such as teacher and learner. The dominant voice will be the one of researcher, although it cannot be separated from the other roles.

2.5 Limitations of the Present Study

This inquiry will not be a statistically significant sample of womens' and girls' experiences. It will be a narrative that is woven from the threads of the stories and letters that were shared among seven women and fifteen grade eight girls. My goal is to develop a narrative that will be an "invitation to participate" (Connelly & Clandinin, 1990, p.8). Peshkin (1985) noted something similar when he wrote:

> When I disclose what I have seen, my results invite other researchers to look where I did and see what I saw. My ideas are candidates for others to entertain, not necessarily as truth, let alone Truth, but as positions about the nature and meaning of a phenomenon that may fit their sensibility and shape their thinking about their own inquiries" (p.280). (Connelly & Clandinin, 1990, p.8)

Connelly and Clandinin (1990) suggest that Crites' (1986) "illusion of causality" (p.168) is a powerful interpretive force for the writer. A sequence of events examined temporally, backward or forward, "tend to appear deterministically related" (Connelly & Clandinin, 1990, p.7). It will be difficult, as I move backward and forward in the narrative, not to suggest that one event was caused by a previous one or will cause an event in the future. These authors also point out that: "narratives are not adequately written according to a model of cause and effect but according to the e..planations gleaned from the overall narrative" (p.7).

The delicate balance between the details of the individual stories and the sense of the whole narrative will be difficult to maintain. The attempt will be made to avoid what Connelly and Clandinin (1990) call "the Hollywood plot, the plot where everything works out well in the end." (p.10). To avoid this, I will be careful to watch for "narrative smoothing" (p.10) which these authors explain as the process of leaving some stories out or obscuring others in order to have the narrative turn out "well in the end". I will try to be "as alert to the stories not told as to those that are" (p.10), and I will attempt to be open about how I have selected the stories. The three women who are central to this inquiry will be asked to read the resulting narrative to examine the truthfulness or verisimilitude of the story.

A limitation of narrative inquiry that Rasberry (1991) mentions, as part of his autobiographical inquiry, applies equally well here:

> Another limitation which may be self-imposed, is my insecurity and self-consciousness at "raising my own voice". At times I feel the double risk of not only developing my own stories, but in using the academic world as my arena for telling them. (p.18)

I feel the same insecurity and self-consciousness that Rasberry did when he wrote this.

CHAPTER 3

COLLABORATIVE STORIES

3.1 The Beginning

Rachel was the first person I spoke with about this project. I met her in 1983 when I started teaching at the local community college. She was teaching communication and life skills and had already been teaching for almost twenty years at that time. I came to consider her my mentor, although I did not share this with her until many years later.

I have come to admire her for many reasons such as her political activism and particularly for her considerable skill in the classroom. Over the years that we worked together I observed Rachel's ability to be sensitive to the needs of her adult students, and the needs of the teachers in the programs that she coordinates. Her openness to new ideas and encouragement to see one's potential provided an environment of collegiality for the teachers and of support for the students.

Rachel continues to support my work, as she has since 1986 when I became interested in these questions about women and mathematics. Any articles or books that she came across would automatically show up on my desk. Even when I moved away from her I still received "care packages" of articles. This interest in my work, and our friendship were factors that first led me to her to discuss this project.

She was immediately taken with the idea of writing about her school experiences when we met in August, 1991 and promised to send me something very soon. As it turns out, these issues hit very close to home for Rachel. In terms of her children or her students, her attitude towards learning mathematics has been positive, but she has been concerned about her own mathematical ability. She had just been assigned some mathematics teaching:

> I have been assigned 4 hours of math teaching a week for the coming academic year. I approach this with reluctance, anxiety and a certain amount of perverse fascination (like sucking on a sore tooth) and also with the pathetic hope that maybe I will learn how to do fractions, decimals and percents this time. I do worry that the students will be short-changed and will quickly lose confidence in me. (letter, August, 1991)

The motivation to examine these early experiences seemed to be strong.

At first, Sally found the task of looking back more difficult than Rachel. Of all of the women who participated in this project, I have known Sally the longest. We met in the

early sixties, the summer after I went to grade one, when she moved in across the street from our house in Ottawa, where I grew up. I always looked up to Sally for many reasons. The most important reason in those days was that she was older than I was (seven months meant a lot then), and I spent most of my time with her friends. She has kept a journal throughout the years since grade school and I hoped that this would help her remember her early school experiences.

I was eager to speak with Sally about this project since we both attended the same schools, grew up in the same neighbourhood and both were very successful with senior level mathematics and science courses. Being a female engineer with a post-graduate degree gives her a perspective different from the other participants in this project who are teachers.

Our long term friendship has gone through times of separation, but I did not hesitate to call her and ask her to consider writing to me. She was hesitant at first, feeling that she could not remember very much, but promised a "good effort", and indeed provided many images that are reflected in the discussions that I had with the grade eight girls.

The third person I have chosen to write about is a friend who I met in the mid-1980s. Catherine's son and my daughter attended nursery school together and we discovered that we lived near to one another. This was the beginning of the discovery of a number of similarities and coincidences in our

lives. We have developed a strong, mutually supportive friendship over the years. Although trained as a high school teacher with a special interest in drama and art, Catherine was not teaching when I met her. She is presently a part-time community college mathematics teacher. She is also, among other things, an artist and an educational software expert.

Catherine had no memory of any anxious moments relating to mathematics as a youngster, but as an adult experienced anxiety towards the subject after she committed to teach it. When I moved to London, Ontario in December, 1990, Catherine took over my job as mathematics teacher in a community college classroom. She wrote about the feelings she experienced after agreeing to take this job.

3.2 Teachers

I have often, in the past, returned to a lesson I was taught in teachers' college which basically said that each of us only really affects one or two students in our entire careers. After listening to many stories of school experiences from women and girls, it seems that teachers may strongly influence more students than they realize and in ways that they may not have considered.

The power of a comment made by one person to another can never really be known unless the person has been given the

opportunity to tell the story of how he or she felt as a result of the comment.[8] Many stories began or were centred around a comment that was made.

Rachel's first few years in grade school were a time of feeling loved, honoured and even special.

> I clearly remember my first day in school. I was in Miss Wood's Kindergarten at Montreal School for Girls, September 1941. For some reason my mother and I were late, all the children were sitting on little chairs in a circle when we came in. Miss Wood was expecting us though, so it must have been prearranged. I had absolutely no idea where I was or why. I was shown my seat in the circle, my beautiful mother leaned over my shoulder, smelling of Chanel, her blue Fox Fur brushed my cheek and she whispered into my ear, "Be good as gold". I savoured her words, I thought they were wonderful and they went round and round in my head all morning. I promised myself that I would be "as good as gold". I gave myself over to kindly Miss Wood who seemed to like me. I had the impression that my mother thought highly of her...
>
> The Kindergarten was a huge bright room with lots of windows. The floor was square linoleum tiles. I can still picture it. I bet I could still find everything in that room, the paints, the scissors, the chalk - I loved it there...
>
> Then to grade 3 with Miss Watson. We now had boys in the class. (They may have been in grade two as well, I barely recall - anyway, by grade three they were evident). Miss Watson was a blonde with curly hair and she was fun. Her husband was a soldier who was overseas. She would tell us about his letters to her. I sat in the front desk in the middle row. Miss Watson always sat on my desk. I was honoured. (letter, September, 1991)

Then in grade four there was a drastic change.

> Grade 4 it all fell apart thanks to Miss Mowat, an ex-army officer. She treated us with hatred and disdain. Her method of discipline was to embarrass.

> I gave her plenty of opportunity as I was neither especially bright nor pretty nor English Protestant. She had a few pupils she used especially badly and I was one of them. It is not necessary here to tell the stories of the hurt and humiliation she dealt out. Part of this centred around math drill and what she called "mental math". This was the first time I had any idea that I was generally "stupid" and especially a "dunce" in math. I simply didn't know until then. Thanks to Miss Mowat, I was convinced and have remained so ever since. She did her job well.
>
> Several other important things happened this year. One was that I "went into my head", - into a fog, pulled the curtain down, dropped out. I was no longer participating in school. The other was that I very clearly remember thinking that I would become a teacher one day and make up for the evil that this woman was doing. I would never treat people like this. This was a kind of political awakening. (letter, September, 1991)

I wrote back to Rachel in response to this story:

> I wonder why your teachers were not able to "engage" you? Why did you feel disconnected? Did you wonder if you were the only one feeling this way or were there other students who felt the same way? Do you have any school records from this period of time where your teachers made comments about you? It might be interesting to look at some of their comments and see if they compare to your own perception. There might be a story there. (letter, October, 1991)

Rachel's next letter was inspired by the questions that I posed:

> I love your questions, they are "right on". The suggestion about early school records is an excellent one. I will ask my mother. I guess I disconnected myself from school as self-protection. I do remember feeling, thinking that this is the way things are. I didn't know there was a choice. I never complained at home. It was simply the natural order, I couldn't spell or learn the times tables and everyone else could. Period!

(letter, October, 1991)

The pain of being embarrassed or singled out in front of peers was an image that was repeated many times in the letters, stories and interviews. One grade eight girl described an incident that happened the year before, and as she recalled the memory her voice quivered.

> Student S13: Once you have a bad experience, any other little thing gets to you. Last year we were doing multiplication tables on the board and she told me to go up - and I'm not exactly the greatest person in the times tables - when I came back to my desk she said "Do you feel embarrassed enough to go home and study?". Like now I've taken everything she has said to me so seriously now (voice quivers) because I like her as a person and her opinion really matters to me - but I was so upset.
>
> Kathy, Researcher: So what did you do about that? Did it make you go home and work on it really hard - or....
>
> S13: No. It made me feel bad about myself. I've had a weird life. I've been put down all the time.
>
> K: So it was one more comment and you put them all in a stack and ....
>
> S13: Yup.
>
> K: It is really hard to step away from those kinds of things, isn't it?
>
> S13: Yeh, especially when it happens right in front of all of your peers. It would be all right if she took you aside maybe but she says it out loud in front of everybody - God. (transcript, grade eight girls, March 9, 1992)

The other students in the class seemed to be listening very carefully to this story. Yet, one student (S3) asked her again if she went home and learned her times table and was told that

she did not. This student (S3) pointed out that if she (S13) had gone home and learned her times table then it would have been "OK", and that she (S3) did not remember that incident at all. This comment provided an excellent opportunity to discuss how we can possibly know how another person is feeling. This discussion of feelings centred around boys which is a topic that will be covered later in this paper.

Another grade eight girl recalled her grade one teacher:

> S2: My grade one teacher graded us. Those who were good could go ahead and those who were bad had to stay back and work with her. That has stayed with me my whole life. I had to stay back and I didn't like the way she graded.
>
> K: Did she use that language - good - bad?
>
> S2: Well .... you and you can go ahead.... (transcript, grade eight girls, March 9, 1992)

That these memories have remained so clear indicates their educational importance in the life stories of these people. When they write and share their stories with me and with others, they begin to explain themselves. We become part of each others stories and are then able to ask what the meaning of the story might be. Connelly and Clandinin (1990) would agree that each of us has the potential to create a new story of self which changes the meaning of the event, and its significance for the larger life story the person may be trying to live.

The grade eight girls agreed very strongly, as a group,

that the teacher should not make a student feel bad in front of all of the other students. Only a few girls in the group felt that they had been embarrassed in front of their peers, but these students were particularly vocal. Other students, equally as vocal, felt that their teacher never made anyone feel "bad".

When I asked the girls to recall any teacher that they had known in the past that they felt was a "really good math teacher" I heard a variety of descriptors, such as: fair, gave you a chance, no labels, complimented a lot, nice, fun.

Mrs. Hogan made Sally feel special in the early years of high school.

> Mrs. Hogan was young (relatively) and skinny and sometimes got flustered. I can still see her skinny arms flapping around in some explanation of molecules or reactions. She was the kind of person who laughed easily, but was always trying not to. I liked her as a person, and I especially liked science.
>
> When I saw her again, many years later, when I went to a basketball game of my sister's or something, she hardly remembered me. This didn't bother me; by then she had taught hundreds of us. But I knew she had influenced my life tremendously.
>
> She was a good teacher, one of the special ones for me. Because of her, I had a safe and stimulating environment for learning. She was truly pleased when we "got into" what we were doing. She gave plenty of encouragement and was my first female role model I guess. Come to think of it, she was the only female math or science teacher I had in high school or university.
>
> She indulged our curiosity and diverted bad curiosity into productive curiosity. She showed us

> there were worlds out there that we had never thought of as children, and that our parents couldn't take us to. I don't think she really favoured me, as her lack of recall indicates, but she did make me feel special. She was interested in teaching science and encouraging all her students to discover its magic. (letter, December, 1991)

Sally also indicated in her letter that Mrs. Hogan did not always approve of her behaviour, yet this teacher was able to "engage" Sally in a way that grabbed her attention. Mrs. Hogan clearly could not have known the effect that she had on Sally, yet Sally describes her as "my first female role model". This teacher made a distinct impression on this student.

This particular story resonated very strongly with me because I also had Mrs. Hogan as a teacher. I did not find myself in the same situations that Sally did but I remember feeling very strongly about Mrs. Hogan and thinking that she was an excellent teacher. This could easily have been my story. How many other students did Mrs. Hogan "influence tremendously"?

The experience that Rachel had in grade four with Miss Mowat was reflected years later in her life.

> After graduation I worked for a year and then applied to do Master's work. I applied to 5 universities, all in different faculties. I was accepted at the University of Arizona in Anthropology, at UBC in Town Planning and at Boston University in Education. I had decided to go to UBC. I enrolled. Then one day I had a flash - a "calling". Go to education, remember your promise to redeem your early school years. I called UBC and cancelled, called BU and got my application reinstated and I was off to a Master's Degree in

> Education at Boston University. It was 1959-60. (letter, September, 1991)

While it is important to consider the power of comments that were made by teachers to students, it is equally important to consider the comments that were never made. Catherine describes the exams that she wrote at the end of grade twelve:

> Near the end of Grade 12, all Ontario students took SAT tests. When the results came back, they showed that I had a very strong aptitude for maths and sciences. Father Shannon, who was also a math teacher, had several conversations with me trying to encourage me to major in math in university and become a math teacher. While my abilities in math had never been questioned before, this was the first time in my twelve years of schooling that any teacher had encouraged me in this direction, although I had high marks from the beginning. Unfortunately, at that point in time it was too little, too late. I had already decided to study sociology, psychology and economics the next year at university. Had I been more receptive to Father Shannon's advice, my eventual path to becoming a math teacher would have been much smoother. (letter, December, 1991)

When considering whether to take a job as a mathematics teacher in the fall of 1990, Catherine felt that she needed to review all of the student modules (there were thirty modules that covered the grades one to twelve curriculum). After briefly reviewing them, about two months before the job was to start, she decided that there was too much material to cover in the time that she had. She decided not to apply for the job.

When Catherine attempted to return the modules to me I

was not home. My husband, who was home at the time, commented to her that "teaching math was a lot like riding a bike - I would be a little rusty at first but the skills I had learned would quickly come back" (letter, December, 1991). This comment turned Catherine around as she loves a challenge and she is a risk-taker.

> During the next few weeks I had two interviews, and began to work my way through the modules, starting from the first one. Because I had been away from math for such a long time, I believed that I could not teach the course properly unless I had reviewed the student modules. This was both to compensate for my memory and to really understand what the students were experiencing. I was pleasantly surprised when I was chosen for the job. By that time, there were four weeks left before my job began, and I had only completed nine of thirty modules. I knew I would really have to scramble to get out in front of the higher level students in the class. I also believed that I would be in deep trouble if I did not, because no matter how good a teacher you are if you lose the students' confidence in the beginning, it is next to impossible to regain it.
>
> I spent the next four weeks doing math from morning till night. It seemed that every day, I would come across a problem that would stump me and I would then be overwhelmed with anxiety. At these moments I felt that I would not be ready, but since I am not a quitter I continued on despite the foreboding and the knot in my stomach. I carried on this way for the entire month, feeling panicky at some point every day.
>
> I did manage to work out a coping strategy. I visited the classroom a few times while Kathy was still teaching. She was extremely helpful and supportive. I got to know the students and Kathy left me detailed information on the work they had completed. When teaching day one arrived, I had managed to cover all modules that students were currently working on, and fortunately I could

> answer all the students' questions. From there I was able to stay ahead of the most advanced students. My apprehension and anxiety faded away on that first day and I have since found teaching math to be a very enjoyable experience.....
>
> I believe that my recent memory problems as well as my math anxiety has helped me to become a more understanding and effective teacher. (letter, December, 1991)

Preparing to enter a classroom filled with adult students working anywhere from grade one to grade twelve would cause anxiety in many experienced mathematics teachers. It is necessary to be prepared to work together with a student to answer any question from any area of the curriculum at any time. It is not surprising that Catherine experienced anxiety when preparing for this job. Her motivation to work her way through the modules was primarily "to really understand what the students were experiencing" (letter, December, 1991). She sees this experience as one that has helped her to become a more understanding and effective teacher.

We can never really know the power of a comment that we make or that we fail to make. Yet, we all can recall comments that were made to us, in the past, that made a deep impression on us. This being the case, we cannot concern ourselves with every comment that we make, but we can provide opportunities for all learners to tell their stories. These opportunities may give those learners that have previously been silenced in the mathematics classroom a voice.

3.3 Parents

The literature on teacher expectations and performance of students is extensive. Likewise, the expectations that our parents have for our success is significant. Sally writes about how important it was for her to have a solid (although strict) home base. She questions whether this has anything to do with mathematics and writes: "All I'm thinking is that anything to do with teaching children, has to include the reality of growing up." (letter, December, 1991).

> My mom tells me she always loved math - but "in those days" it wasn't pursued by girls. She was a bookkeeper, as you know, so she probably exuded a positive influence. It was she who mentioned being "off the hook" when new math came in. She also said my Dad always wanted to be an engineer (I never knew this), so he must have been a subliminal influence too. I do know I always wanted to please them (well most of the time) and it pleased them for me to do well in school. (letter, October, 1991)

It is interesting that Sally discovered that her father had always wanted to become an engineer. She sees this discovery as a possible "subliminal" influence on her. Sally does not mention how her parents felt about her choice of career but she does write about her teachers:

> When I chose to go into engineering, my high school teachers were supportive, but almost condescendingly so. They tried hard not to discourage me, but you could tell they couldn't really believe it would work out. Indeed it nearly didn't as you know; in first year I tried to drop out, until an extraordinary prof made me see I was

> dropping out because I was afraid I was going to fail, not because I really was failing. (letter, October,1991)

Rachel's parents wanted very much for her to be successful with mathematics. They hired tutors for her because they were not able or they did not have the patience to help her themselves.

> I remember my father trying to help me (it must have been around grade 5 or 6). I can still see the scene. We are sitting in the living room at a card table, pencils sharpened, lights on, books and paper. My younger brother is at the table with his math homework as well. He couldn't do the math either! This lasted half an hour at the most and was never repeated. I clearly remember my parents arguing and my mother making excuses for me, after all she said, she couldn't do arithmetic either, had also failed in math at school and what did it matter anyway, I'd probably never need it. I remember the feeling of relief when I realized that I was being excused. My brother, on the other hand, did not have the benefit of being female and was expected to be able to do his arithmetic homework well. (letter, August, 1991)

I recall my own memories of my father unsuccessfully helping me with my math homework as I was unable to understand his "way" of solving the problem. Each of us needs to develop our "own ways" of solving problems.

Some of the grade eight girls expressed the same frustration when asking their parents for help.

> S?: When I ask my parents for help they explain it like I already know it.
>
> K: Does anyone else have any comments about asking your parents?
>
> S?: They seem to go all around the question.

S13: When I ask my mom she says "I've had a long day" - like as if I haven't had a hard day too.

S2: They are pretty good about answering questions in math - well my mother doesn't know very much about math but my dad is very educated in math and my brother is in high school. (transcript, grade eight girls, March 9, 1992)

Other students enjoyed working with their fathers on their mathematics homework, and none of the girls mentioned working with their mothers on their mathematics problems.

3.4 Personal Decisions

After the grade eight girls discussed teachers and parents I was interested in asking them who they felt was the most powerful influence in their lives, in terms of making decisions. They were somewhat unsure of what I meant. The word power was a term that seemed unfamiliar to them.

K: I think that we would all agree - whether or not you like your teacher - math is very, very important. It is a requirement for almost every course that you might want to do after high school. What I'm getting at is - who has power over us - like who affects how we feel about what we are going to do as we go along - who makes the decision? Who is the powerful person?

S6: I think it is the teacher.

K: Who is it?

S?: The teacher.

S?: My parents.

S?: Us.

> K: Some people say the teacher, some say parents, some say us. What is the bottom line?
>
> S2: Some people have no power. I don't have any power with math.
>
> K: That is not true.
>
> S2: Well, yah, I've got ...well - I don't have a natural power with math. I have to work to understand math..... (transcript, grade eight girls, March 9, 1992)

The transcript does not reflect the fact that the greatest response to my question was that parents and teachers were the powerful people in their lives. Only one or two students suggested that they themselves had the power to make their own decisions.

Student S2 understands mathematical power as a "natural" power that would allow one to avoid "work" to understand mathematics. It seems, for this student, as if mathematics is out there, in a box - something that has already been done by someone else before. There were a number of other comments that suggested that some of the girls felt that you either were "good at math" or you were not, which is evidence of the dualistic approach to this subject referred to by Buerk (1982).

> S5: Some people think mathematically and some people think in other ways...
>
> S3: Math is here (one hand) and your life is here (other hand)...
>
> S10: It's like a track that she (the teacher) is trying to put you on to get you to a mathematical

> mind and some people don't even want it. She says things that upset me sometimes...
>
> S?: Some people pick up on math really quickly and some people have to work really hard. Those people who are good at math - I like math...
>
> S2: If I hadn't moved and I had learned my basic facts then maybe I'd be good at math...
>
> S?: Some people just really like math and others keep at it because they know that it will be important in the future... (transcript, grade eight girls, March 9 & 12, 1992)

These comments were generally supported by the group. There was one exception to the general feeling that mathematics and life are separate entities:

> S4: I love math right now because of the teacher.
>
> S?: This teacher helps us keep our math really organized and that carries over to other subjects.
>
> K: Are you saying that some of the skills that you are learning in math you are able to apply to other subjects?
>
> General: Yah ...
>
> K: Is that a consensus? Yah ... (transcript, grade eight girls, March 9, 1992)

This is an example of how difficult it is to separate the teaching or learning of mathematics from mathematics itself. The girls felt that the organizational skills that they were learning in mathematics class were helping them in other subjects, but this is not the same thing as connecting mathematics to the other areas of their lives.

In the first letter that Sally wrote to me in October,

1991, she states:

> You know, I don't really think I have a head for math either; certainly not like Bob does. I don't have an instinctive feel for numbers, I have to work it out. And I can work it out.

I was surprised when I read this part of the letter because I imagined that successfully completing an undergraduate and a post-graduate engineering degree should be enough evidence for a person to feel that they had a "head for math", in any sense of the phrase. When Sally compares herself to Bob, her husband and an engineer, she feels that his sense of numbers is better than hers. Yet, she does express the confidence needed to be successful: "I can work it out". I can distinctly remember a time when I said to myself that no matter what the problem is I can work it out. I understand this memory as my decision that I was able to do mathematics.

In a letter written later (December, 1991), Sally writes of discussing her understanding of her own "feel for numbers" with Bob and she suggests that maybe she does have a "head for math".

> Bob tells me he doesn't have a "head for math" in the way I assumed (and previously reported). His math sense comes from years of dedicated homework. He was the kind of guy who did his learning through homework and apparently he spent hours and hours on math. He "applied" himself with dedication, as he does to this day. He says that is why he takes too long (in his own estimation) to get things done, that he never learned shortcuts or conceptual learning like I did. He says he works from beginning to end with all the details included whereas I skitter about intellectually and end up

> at the same place. Different learning styles. ...
>
> I am much lazier. Perhaps I have a better "head" for math than I thought, because I never did all the assigned homework. But I did have the "passion" (again, Bob's word). But I believe it is the lack of detail, the lack of drilling, which leaves me vulnerable to the feeling of being an imposter. That and the fact that my world by then was almost entirely populated by men. (letter, December, 1991)

Sally re-considers her original idea about herself in terms of having a "head for math". The process of living her life story, telling her story to me, and explaining it to Bob resulted in an interesting change in her story.

This is one of many places in Sally's stories where I share her experience. I have always described myself as someone who has to work very hard to accomplish the same things that seem to come more easily to other people. I therefore considered other people, my husband included, to have a better "head for math" than I have. I have since come to realize that "different learning styles", as Sally says, are characteristics of a person and distinguish one person from another. Yet, no one learning style is superior to another in every situation.

An interesting connection appeared between a grade eight girl and two of the women that met in a small group to read their stories. Student S5 begins:

> S5: When I was learning my basic facts I didn't really learn them very well. It wasn't really taught to me that well. So that stayed with me. Then I moved and that really stayed with me. I feel

that I don't like math.

K: So the moving in the middle was difficult?

S5: Yah.

K: So you feel that you haven't been able to catch up? So is that your fault, do you think?

S5: Well, Probably partly that and I didn't try hard enough. (transcript, grade eight girls, March 9, 1992)

This sense of not trying hard enough or doing enough work in mathematics showed up in the transcript of the small group of women who met in December, 1991, to read stories to each other. Catherine was present along with Christine and Anne. Early in the discussion I ask Christine to read her story and she responds:

C: I didn't have any trouble thinking of something to write about. I hate it. I'm dealing with math in university now and I feel that I can't do it because I'm lazy or something.

Later in the discussion Anne reads her story of how unsuccessful she was in senior level mathematics courses in high school, after she had done very well in all subjects up to this time.

K: It must have been a conflict because you had been so successful in all subjects up to this time.

A: I thought that it was because I was lazy and I wasn't working hard enough.

K: This is exactly what Christine said earlier.

A: I don't feel that I am naturally smart. I really have to think. That can really undermine you as a teacher. (transcript, December, 1991)

Note: Anne is an elementary school teacher with a specialist is special education.

Each of these women and this grade eight girl felt that if they had worked harder then they might have been more successful in mathematics. Yet, they somehow felt that the need to work very hard must have indicated a lack of ability. This resonates closely with my own story of having to work very hard in mathematics to be successful, as if this also indicates a lack of ability. It appears that whether one is successful with mathematics or not, there still seems to be a number of questions within ourselves about our ability to participate in this subject, and the amount of work that is required to be successful.

Walkerdine and her associates (1989) have examined the issue of "hard-working" as a term used less frequently to describe "good boys" than "good girls". In their study they found that words like "natural ability" and "flair" were used to describe the top ranking boys but rarely to describe the girls. High ranking girls were more commonly described as hard-working. The implications of this, as suggested by Walkerdine (1989), are that any child who is seen to be working hard must be lacking in ability or "flair": the qualities which produce good attainment without effort or work. I personally have fallen into the trap of describing a student as only able to progress if she works very hard, as if

this is a negative characteristic.

Sally's discussion about having a "head for math" was part of a larger story that she wrote to me in a letter dated December 1991. She titled the story The Imposter Syndrome.

> It seemed all a mistake. There I was graduating and being shipped off to a job I knew nothing about. This was my first conscious case of the imposter syndrome. But in retrospect, it had happened before and has happened since.
>
> The difference between insecurity, or fear, or plain old healthy nervousness, and the so-called imposter syndrome is, to me, the element of it all being a mistake. You've been faking it so long, so well, that you begin to believe it yourself. And now all of a sudden, you realize you can't do it and you are going to be "found out". Women, well me anyway, really can't do math, or women really can't be engineers. Maybe it's just fear of success. ...
>
> The last time I suffered a severe case of imposter syndrome was when I got my last promotion. A learned and admired colleague was making comments to mutual friends how it was inevitable because I was a woman. This shook me to my core, because there was an element of truth in the fact that the authorities were delighted I had measured up and could be promoted (to the level of my male peers). I am the only female engineer at that level in the agency. I went into months of self-doubt and lost the friendship of that colleague forever. Even my own husband asked if I had "provoked" the personal attack of my colleague. But the muddle through factor applies again, and somehow I survived the self-doubt and so far I'm okay with it. (letter, December, 1991)

Sally did not question her ability to do well in primary or secondary school mathematics. In university, surrounded by other engineering students, most of whom were male, she started to question her calling. She suggests that this

feeling, that her graduation or her promotion "is a mistake", may be the fear of success. She is careful to put these feelings into perspective, yet it is clear that these times of self doubt are painful and require her to make a personal decision to keep moving ahead.

3.5 Boys

When I listened to how the grade eight girls feel about boys I had the sense that things have not changed very much since I was in grade eight, twenty years ago. The one aspect of the discussion that did not seem familiar to me was that the girls feel the boys do not value them very highly. The group of grade eight girls that I spoke with felt this to be true.

> S: Okay, getting back to girls and boys - sometimes girls get up really high because they feel special about somebody so they'll think good about themselves but if they're not they won't.
>
> K: They feel good about themselves if what?
>
> S: If they go out with someone - they feel special if someone likes them.
>
> K: So, if a boy likes you, you feel special?
>
> S: Yah.
>
> K: Are there other ways to feel special? I mean, is

this the only way to feel special?

Group: NO - there are other ways.

K: Is it the most important way to feel special?

Group: No...Yes... NO...

S3: I think most teenage girls, our age, think that it's the best way to feel special. If a guy likes you it's the best feeling in the world. But if a girl likes a guy from the guy's point of view I think they just think: "Oh well, another one to add to my collection - maybe I can score with her or something." - that's what I get the impression of...(agreement from the group)

K: Do you think that girls value boys higher than boys value girls?

S3: Yes, absolutely. (agreement from the group)

S: Boys think that they are high and almighty and we're the little peasants. (transcript, March 12, 1992)

At other times during my discussion with the grade eight girls the issue of the difference between the boys and themselves came up. They seemed to see the boys, as a group, as very different from themselves:

S6: Getting back to boys and girls - when the teacher calls the boys stupid it doesn't bother them but when she calls the girls stupid you can see them starting to cry. ...

S?: Girls take it to heart. Boys think the teachers are having a bad day. ...

S?: Girls have the emotional part and boys just have the physical part - they don't have that much emotional. ...

S?: If you like a guy and it gets out or you tell them and guys hide their feelings - then the guy knows and feels: "Oh, I'm so good." and everything.

> Guys don't let the girls know so they feel: "Oh, nobody likes me.". So they don't feel as good about themselves - they feel something is wrong with them. ...
>
> S?: Girls care more about what people think, guys don't care. Guys think well I think I'm best so I must be the best. (laughter) ...
>
> S3: I know of a situation where the guy asked her out and she said no and the guy said: "Oh, no big deal, it's just a girl.". When a girl asked out a guy, he said no and she cried. So the girl cries and the boy says it's just a girl. ... (transcripts, March 9 & 12, 1992)

The girls never compared their mathematical ability to the ability of the boys. They did spend a good deal of time discussing their observations that the boys are not as emotional, not as caring, and not as sensitive as they are. There is a strong connection between these observations and the misgivings that the girls expressed about performing in front of their peers, particularly being singled out due to poor performance.

What does this have to do with mathematics? This is actually Sally's question from earlier in this paper. She answered it by saying that anything to do with teaching children has to include the reality of growing up.

Reality for these grade eight girls is that boys and their attitudes towards the girls are very important. Yet, even though they feel the boys are lacking some of their own emotional characteristics, they seem to feel that these characteristics put them at a disadvantage. Perhaps if they

weren't so emotional or so sensitive they would be more successful in the mathematics classroom, more able to perform in front of the group, more able to accept criticism. Unfortunately, this would be to deny who they really are and the ways in which they have come to understand their relation to the world.

If mathematics is presented in a way in which all participants are allowed to be themselves and to have a voice, it appears as if these grade eight girls would feel more comfortable. Allen (1991) suggests that this may be possible if we examine the educational dialectics of Belenky et al (1986) and concentrate our efforts on presenting mathematics as:

> a process in which one engages in the company, and with the support of others, if the content of mathematics courses derives from and relates to the real world, if the teacher appears to be a genuine learner interested in supporting and encouraging the evolution of learning in the student, then perhaps mathematics and mathematics classrooms will become less female-unfriendly. (p.7)

CHAPTER 4

SUMMARY

The most easily identified themes in the stories, letters and interviews centred around teachers and parents. Most of these women and girls recalled teachers who had been very good and teachers who had not been very good. As a group of learners, the participants were clearly cognizant of what qualities of a teacher were necessary for them to feel comfortable in the classroom. Many of them did not like to be singled out or embarrassed in front of their peers and the stories of the pain that was felt over these instances were particularly memorable, even if the pain was caused by a mere comment from one person to another.

The teachers who were remembered fondly made their students feel special, cared for, honoured and liked. This suggests that as teachers we need to communicate with our students on a level that we may not have considered previously. If the opportunity to write about early school

experiences is provided to all students, then the potential exists for the sharing of stories that might not have been shared otherwise. This includes the opportunity for teachers to share their lives with their students.

I also heard from the participants that teachers who made or who make connections to real life were and are the best teachers. Possibly the separation between life outside the classroom and life inside the classroom should not be so clear. I personally get a tremendous amount of satisfaction from connections that students make between their lives in and out of the classroom. Unfortunately, these do not occur often enough.

The amount of material referring to teachers outweighed that of parents, yet parents and their support or lack of support, were mentioned by many of the women and girls. The wish to do well to please parents was evident, yet frustration in dealing with "help" from parents was also expressed.

A number of other themes were not so easy to identify and these themes need further research. It seemed that only a few of the grade eight girls were aware of their power to make decisions for themselves. There was some evidence in the discussions with them that they see their lives as very separate from mathematics. This supports Buerk's (1982) suggestion that a dualistic approach to this subject may prevent it from being approachable by girls and women.

It is very difficult to measure or even be aware of how a person's story changes once it has been shared. I was astonished to find out how much my own stories changed when I participated in this process.[9] As we share our experiences in order to explain ourselves to each other, we continue to develop our subjectivity. This process opens the door for people who previously felt that they could not do mathematics. It gives them the opportunity to examine memories that they understood as failure and possibly see them in a different light.

The connection between hard work and ability surfaced in a few stories. Of all the themes that appeared in this inquiry, this theme appears to cry out for further research. The participants showed a wide range of success with mathematics, but a narrow range of self-confidence with the subject.

Boys are very important to grade eight girls - as they have been for the last twenty years and much longer. The sense that the girls have of the boys placing a lower value on them than on other boys was of great concern to the girls. Some believe that the "best" way to feel special is to have a boy like them, yet they feel that the boys do not place very much value on girls.

These are the themes that arose from an inquiry involving seven women and fifteen grade eight girls over a nine-month

period. It is not appropriate to suggest that these stories are the stories of all women and girls, or that they provide a statistically significant sample. They are interesting stories of experience that continue to be written as these people live their lives.

I am currently teaching mathematics in three different community-based classrooms (located in the community centres of government subsidized housing projects). Every week I listen to more stories of early school experiences, and often I share my stories or the stories of others who have affected me, with my students. This process of telling and re-telling stories is an integral part, not only of the environment of the classroom but of the curriculum. I encourage mathematics teachers to tell their stories and to ask their students to share their stories as well.

NOTES

1.Allen (1991) recommends the chapter by Lindsay A. Tartre in Fennema and Leder (Eds.) 1990, Mathematics and Gender, New York: Teachers College Press for a discussion of the problems relating spatial ability and mathematical ability.

2.National Research Council, 1989, Everybody Counts: A Report to the Nation on the Future of Mathematics Education, Washington, D.C.: National Academy Press, p.23.

3.For an excellent discussion of the conflict for girls and women between femininity and intellectual excellence the reader is referred to Walkerdine's (1990) School Girl Fictions which contains a chapter called Femininity as Performance (which was previously published in 1989 in Oxford Review of Education, vol. 15, no. 3).

4.Magda Lewis suggested this idea when commenting on an earlier version of this paper in June 1990. I wish to express my appreciation to her.

5.Connelly & Clandinin (1990) suggest that one of the best introductions to the scope of the literature on narrative inquiry is Mitchell's (1981) book On Narrative.

6.Rasberry's (Queens's University, February, 1991) unpublished thesis proposal, entitled The 'Good Kid': A Central Voice In Building a Narrative, has been helpful in summarizing the educational applications of narrative inquiry and the origins and development of the narrative method in education.

7.Connelly and Clandinin (1990) discuss the importance of distinguishing between a chronology (a series of events that are clearly linked) and a narrative (a chronology with the meaning of the events and the plot which gives the explanatory structure for linking the events).

8.As part of a graduate course at the Faculty of Education, Queen's University, Kingston (see note #9) Dr. Rena Upitis originally provided me with the opportunity to consider this idea.

9.During the summer of 1991 I participated in a course entitled Topics in Discursive Research: Narrative Inquiry in Education offered by Dr. R. Upitis at Queen's University, Kingston. During this course we wrote a chronology and stories of our life experiences and shared them with the class. In the end we developed our "philosophy of education" based on the themes of our lives. By participating in this process I came to realize the power of our stories and the potential that exists for change. I wish to express my appreciation to Dr. Upitis.

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APPENDIX A

LETTER OF PERMISSION

March 5, 1992

Dear Parents and Grade Eight Girls,

In our society today, the study of mathematics is becoming more and more important. Yet, fewer and fewer students are graduating from high school with credits in senior level mathematics.

I am a parent of two children at _____ school and I am also a student of the Faculty of Education at Queen's University.

I am studying the attitudes that women and girls have towards learning mathematics and I would like to meet with a group of grade eight girls at _____ school to talk about how we feel about learning this subject.

I would like to ask these students about their earliest memories of school and if they have any memories of learning mathematics that stand out for them. I am also interested in how they feel about taking mathematics in high school.

Participation in this discussion is voluntary and no one will be asked to share a memory or a story if they do not wish to. I will tape record the discussion but no names will be recorded or used.

Thank you for your co-operation and if you have any questions, please feel free to call me at _____ .

Kathy McSheffrey

****

I, _____ GIVE MY PERMISSION FOR

_____ TO PARTICIPATE IN THE DISCUSSION OF ATTITUDES TOWARDS MATHEMATICS, IF SHE WISHES TO.

_____
DATE