

TOWARD ACTION RESEARCH
AS A VEHICLE FOR
IMPLEMENTING THE NCTM STANDARDS
IN SECONDARY MATHEMATICS CLASSROOMS

by

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Abstract

This thesis depicts a story of three teachers, one of whom is the researcher, who are trying to implement aspects of the National Council of Teachers of Mathematics (NCTM) "Standards" through the use of a collaborative action research model. The study investigates the research question, "What themes recur when teachers use collaborative action research as a vehicle for implementing the NCTM Standards?"

The teachers worked together from June, 1994 to February, 1995, meeting twice a month during the school year. Each teacher developed their own action research cycle for exploring some aspect of the Standards. In addition, this researcher documented the progress of the group. Data analysis revealed five themes which seemed to affect the feelings of success experienced by the participants. These themes are: research expertise, structure, classroom research focus, readiness and group discussions. Although these themes permeated and grew throughout the process it is important to note that their labelling and indeed recognition of their nature was not complete until this researcher analyzed data after the project action research cycle ended.

This researcher recommends that government officials, universities and school administrators provide incentives for change, support for implementing change and opportunities to link with full time researchers. University action research instructors may consider

providing a practical experience component to action research courses. Mathematics teachers may find it helpful to determine their “stage of readiness” in relation to the Standards before they embark on an action research project. Becoming comfortable with Standards oriented activities seems to be an important component of realizing the Standards vision in one’s teaching practice.

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Chapter 1

Introduction

Since I began my career as a mathematics teacher, I have been aware of a move towards mathematics instruction that is quite different from what I experienced in my high school days. In my year of teacher education I learned about two types of understanding, "instrumental" and "relational" (Skemp, 1978). Through reflection, I realized that I had learned mathematics *instrumentally*. I had simply memorized what procedures to do in particular situations. I was not aware of the relationships between the concepts that I had been working with nor did I understand the meaning behind the procedures. I had not built up a "conceptual structure" from which I could "produce an unlimited number of plans" (Skemp, 1978, p. 14) for completing tasks such as solving unique problems. Ironically, after completing a Bachelors degree majoring in math, I did not feel that I could even contemplate doing a Masters degree in mathematics. Despite my first class standing, I had never actually "created my own path" in mathematics and thus I did not feel confident or competent as a mathematician.

Six years after completing my bachelor degree, I started my career as a teacher of Mathematics. I found myself learning mathematics all over again, this time relationally. I was thrilled at the connections I found between the different concepts. To this day, I continue to discover concrete understandings of procedures I had previously just

memorized.

I recognized the need to develop a teaching style that would enable students to learn mathematics relationally. As a teacher, this meant I must allow for more problem solving, exploration, and discussion. Unfortunately, this was not an easy task. I had been educated in a system that traditionally focuses on the memorization and drill of procedures. I had no prior experiences with alternative ways of teaching for the basis of my teaching style. Consequently, I reluctantly became a teacher very much like those teachers with whom I had learned instrumental mathematics.

The NCTM Standards

I decided not to give up hope. I continued to attend conferences and workshops aimed at the theory and practice of teaching children relational mathematics. I also became a member of the National Council of Teachers of Mathematics (NCTM) and the British Columbia Mathematics Teachers Association (BCAMT). The former of these two organizations is based in the United States but has a large Canadian membership. In 1986, the NCTM organized the Commission on Standards for School Mathematics from which the Curriculum and Evaluation Standards for School Mathematics were produced in 1989. Many articles and workshops, based on the Standards provide teachers with descriptions of what children could be doing in the classroom. Two years later another commission was formed called the Commission

on Teaching Standards for School Mathematics and in 1991 they produced Professional Standards for Teaching Mathematics. This volume included vignettes of what teachers can do to help their students best achieve the standards. NCTM has since produced several addenda booklets to the standards on such topics as Geometry, Data Analysis and Connecting Mathematics. The "Standards" (the two volumes and addenda series) set the tone for mathematics education reform in the United States and Canada.

As I continued to make changes in my teaching practice, armed with theory and concrete examples, I still often felt scared, alone, defeated, and tired. Many of my colleagues experienced similar frustrations and some chose to give up and return to traditional instruction.

In 1992, I started a Masters Degree in Mathematics Education. Two things happened. First of all, I came to learn more about the reasons for difficulties my colleagues and I experienced. For instance, the vision of the Standards and the reality of the B.C. Curriculum are philosophically at odds with each other. Secondly, I discovered a vehicle through which I could implement the Standards in a structured environment. That vehicle was collaborative action research.

Philosophical Differences

The B.C. Mathematics Curriculum Guide (Province of British Columbia, 1987) is broken down into "intended learning outcomes";

specific content or skills, most of which are pre-calculus. This reflects an *academic rationalist* perspective. Eisner (1985) states that the central aim of the academic rationalist curriculum is "to develop man's [sic] rational abilities by introducing his rationality to ideas and objects that represent reason's highest achievements" (p. 57). This means that what content students learn is predetermined and since there is a great deal of content it is most efficiently taught from a *transmissive position*. In such a position "there is primarily a one way movement to convey to students certain skills, knowledge, and values" (Miller & Seller, 1990, p. 6). The students are often involved in rote learning activities. The role of the teacher is to impart information to the students and to help students by correcting their work or misconceptions. This type of teaching is often referred to as "teacher centered" since the teacher is the ultimate authority and maintains the locus of control.

The perspective reflected in the Standards is quite different from that contained in the B.C. mathematics curriculum. In contrast to the B.C. Curriculum, the Standards are more child-centered and do not reflect a transmissive position; they are better described by the transactive position. The *transactive* position is one in which it is assumed there is an interaction between the student and the curriculum (Miller & Seller, 1990). Within this perspective is the *cognitive process* orientation. Generally, the aim of this orientation is life long learning. Eisner (1985) states it is important that "teaching is not to impart, but to

help students learn to inquire" (p. 51). This means strengthening the cognitive processes or intellectual skills such as "the ability to infer, to speculate, to locate and solve problems, to remember, to visualize, to extrapolate" (Eisner, 1985, P. 51). Vallance (1986) adds to this list "the development of powers of reasoning, analysis, criticism...[and] judgment" (p. 25).

The Standards explicitly promote these objectives. In fact, at every grade level is a standard called "Mathematics as Problem Solving" and a standard called "Mathematics as Reasoning." Within these standards are statements like, "reasoning is fundamental to the knowing and doing of mathematics...students need a great deal of time and many experiences to develop their ability to construct valid arguments in problem settings and evaluate the arguments of others" (NCTM, 1989, p. 81). These objectives can be found throughout the other standards where one can find phrases like "interpret", "appreciate the power of," "analyze relationships" and "develop an understanding through investigating."

I should point out that the objectives of the Standards are useful for all citizens in our society (not just calculus bound students) but can be extended to involve the use of academic ideas or notation. A negotiation between the teacher and the student as to when to pursue these extensions is recommended.

The Standards document varies greatly from the B.C. Curriculum guide in that it describes activities through which learning can take place

rather than listing specific content objectives. There are two beliefs that support this design. One belief is that in a content oriented perspective, an attempt is made to force *intended* learning outcomes and ignore other, *unintended* learning outcomes, whereas in an activity oriented perspective, all outcomes are valued; intended and unintended.

The other belief is that problem solving activities foster the development of cognitive processes. Eisner (1985) states that "the reason problem-centered curriculum is attractive to those emphasizing the development of cognitive processes is that the opportunities to define and solve problems are among the most critical intellectual abilities the school can foster" (p. 54). NCTM (1989) sees problem solving as the "central focus of the mathematics curriculum" (p. 23).

It is apparent thus far that the B.C. Curriculum was developed within an academic rationalist orientation while the Standards are based on a cognitive process orientation. Vallance (1986) states that while the "cognitive process orientation sees the development of intellectual skills as the chief purpose of schooling...academic rationalism is nearly the opposite, assigning mastery of the knowledge accrued through intellectual tradition and the transmission of culture to each generation" (p. 25). By using the word "opposite", Vallance implies that these two paradigms don't mix. They are like water and oil.

I would like to expand on Vallance's point by highlighting four tensions: content/skills versus life long learning, university oriented

focus versus personal relevance and self-actualization, curriculum differences and cultural expectations.

Content/skills versus life long learning.

Many teachers see the importance of teaching life long learning process skills, as advocated by the Standards, but feel that there is already too little time for covering the B.C. curriculum content and skills.

University oriented focus versus personal relevance and self-actualization.

The content of the B.C. curriculum prepares students for university Calculus, while the Standards have personal relevance and self-actualization as it's aim. It is a struggle to give personal relevance to a curriculum that 90% of the students will never use.

Curriculum differences.

A third problem is the type of questions or problems with which the students must work. The examples given in the B.C. mathematics curriculum guide are closed-ended (one-answer) questions while the Standards stress open-ended type questions. The former elicits a "correct" answer response and the latter allows for different views and different values. A teacher will have a difficult time trying to encourage creativity and speculation when students know that ultimately they are expected to find the single correct answer.

Cultural expectations.

The last problem that I will point out has to do with the expectations of the parents (and perhaps the administrators). The curriculum guide lists a set of specific skills that the students should learn. It is the teachers responsibility to impart knowledge about these skills, assess students acquisition of these skills, and "fix" the student if the skills are not learned. The Standards focus more on the development of the cognitive processes which require the student to construct their own meanings through experience with examples and counter examples. The dilemma is, by "fixing" a child's understanding of the content skills the teacher actually counteracts the development of cognitive process skills because the child is not given enough time to construct his or her own meaning. Students see the teacher as the ultimate authority and learn to be given the knowledge they require rather than struggle for their own understanding.

The contents of the B.C. Mathematics curriculum is not unique. Many curriculum guides, text books and assessments focus on specific content/skill outcomes. Therefore, teachers throughout the world are struggling with these two orientations. In chapter two, I discuss on a broader scale, the specific problems that arise when a teacher tries to adopt a more transactive or student centered approach within a system that largely supports the transmissive orientation.

Collaborative Action Research

A second "revelation" for me during my Master's program, was the discovery of a vehicle through which I felt I would be able to cope with the challenges of changing from a transmissive teaching style to a transactive teaching style. That vehicle was collaborative action research. Action research provides a cyclical structure for implementing change. The cycle involves planning, acting, reflecting and replanning (Carr & Kemmis, 1986; Garcia, 1992; Lampert, 1988; Sagor, 1992). These cycles will be discussed further in chapter two.

Collaboration, in this study, refers to the collaboration between researcher and participants, where "each team member shares in planning, implementing, analyzing and reporting the research and that team members contribute unique skills and expertise in a collective process" (McKernan, 1988, p. 180). Collaboration between a researcher and a teacher was important to me because, as a teacher, I always felt a large gap between what research showed and what I experienced in the classroom. Action research situates the research in the classroom and requires the voice of the teacher, while collaboration provides a bridge for the gap between academic theory and actual classroom practice. Teachers who choose to make changes in their teaching style through collaborative action research need to have access to academic theory in order to facilitate reflection on practice (Elliot, 1989; Paszek, 1989). Paszek (1989) suggests that "an outside collaborator from the university

is ideal because then there is someone who can take the time to do the review of literature and supply any readings that are needed to the practitioners. The outside researcher can provide the impetus and motivation to continue the research" (p. 87).

A key element of collaboration is discussion between teachers. Walt Werner (1988) argues that beliefs are a central factor in implementation and that "clarity of beliefs may emerge through actual use of an innovation, through informal talk, and through regular planned discussion sessions in which participants identify the elements of change" (p. 9).

Such systematic cyclic inquiry into practice provided by an action research model and the clarification of beliefs through discussion facilitated by an academic specialist led this researcher to develop a collaborative action research project for implementing the NCTM Standards.

Goals of this Study

I have chosen the Standards as a focus for this study because I believe in the ideas behind the Standards philosophy. I recognize the tensions involved in implementing the Standards within a transmissive oriented school culture. I envision that collaborative action research will be a vehicle through which I may realize my goals in a supportive and structured environment.

This study records the personal experiences of three teachers,

including myself, involved in a nine month long, collaborative action research effort to implement aspects of the NCTM Standards. I began the study with the following research question:

What themes recur when teachers use collaborative action research as a vehicle for implementing the NCTM Standards?

What follows is a story of my continued growth as I have come to understand the Standards and the collaborative action research process.

The story begins in this chapter with a description of experiences in my first five years of teaching. Chapter 2 summarizes the literature that influenced the development of this study. Chapter 3 explains the research approach used in the project. Chapter 4 leads the reader through the project as I experienced it. And Chapter 5 completes the story with some discussion on the themes that permeated the data and makes suggestions for further study.

Significance of the Study

I feel this is an important story to tell because the Standards have come to be valued internationally by the mathematics community. In October, 1993 the Ministry of Education in British Columbia adopted the Standards as official resource material and in 1994 a committee of teachers was formed to revise the B.C. Curriculum so that it is better aligned with the Standards. Many school districts are emphasizing life long learning skills such as problem solving, reasoning and mathematical communication. There are many questions to be answered in the wake

of mathematical reform. Curriculum developers and educational planners need insight into the constraints preventing educational reform and possible structures for teachers to overcome these constraints.

Analysis of the action research process as teachers implement the Standards, provides insights into such a professional development project, and raises further questions we must explore as teachers make curricular changes.

Chapter 2

Review of Literature

Why the NCTM Standards?

The public educational system was originally structured to meet the needs of an industrialized society. The goals of mathematics education were to produce trained workers for factories, fields and shops. Most students needed only basic arithmetic skills. As we enter the 1990s, the economic base of society has shifted from industrial to informational. There is a call for change in the teaching and learning of mathematics by the National Research Council (1989). The NCTM goals advocate that students:

- 1) learn to value mathematics
 - 2) become confident in their ability to do mathematics
 - 3) become mathematical problem solvers
 - 4) learn to communicate mathematically
 - 5) learn to reason mathematically.
- (p. 5)

There are numerous mathematics educators who have addressed one or more of these goals. For example, James Hiebert (1984) has written about conceptual knowledge which involves children's' intuitions and understandings about how mathematics works, and knowledge about symbols and rules. He states,

Many children do not connect the mathematical concepts and skills they possess with the symbols and rules they are taught in school. I shall argue that it is the absence of these connections that induces the shift from intuitive and meaningful problem-solving approaches to mechanical and meaningless ones. (p. 498)

Others have offered strategies such as cooperative learning (Davidson, 1985; Slavin, 1989; Slavin & Karweit, 1985), inquiry mathematics (Wood, Cobb & Yackel, 1991), and facilitating student conjecturing (Lampert, 1990).

These strategies support the transactive or child-centered paradigm. The Standards attempt to describe this philosophically different approach to teaching mathematics. For an individual teacher this may mean getting their students to work in groups, providing more problem solving activities, teaching students to make conjectures or having their students write about mathematics. But I feel it is important for individual teachers to choose what part of their teaching practice they would like to change first. The Standards provides an overview of a variety of teaching strategies from which an individual teacher can develop a plan for change. It is for this reason that I have chosen the NCTM Standards as a vision for this project.

Challenges to the Traditional Classroom Culture

In Chapter One, I discussed the differences between the transmissive perspective of the B.C. Curriculum and the transactive perspective of the NCTM Standards. I will now take a closer look at the forces that prevent teachers from implementing aspects of the Standards. Those forces stem from the deeply embedded cultures of the classroom, the school and the system.

NCTM openly recognizes the vast differences between the

culture of the ideal "Standards" classroom and that of the typical classroom as we know it today. Teachers will have to re-evaluate their instructional methods in terms of the cultural organization, norms, and core pedagogy. Consequently, the meaning of change is not simply that teachers implement single innovations effectively. Fullan (1991) explains that, "it means a radical change in the culture of schools and the conception of teaching as a profession.... Cultural change requires strong, persistent efforts because much of current practice is embedded in structures and routines internalized in individuals, including teachers" (p. 142). It is therefore, imperative that we understand the nature of the existing school culture as we consider educational reforms that affect it (Cuban, 1982; Lovitt, Stephens, Clark & Romberg, 1990; Richardson, 1990; Romberg, 1993; Werner, 1991).

In general, the nature of the school classroom and the way teachers teach has not changed since the early 1900s (Cuban, 1982; Goodlad, 1983). Cuban describes high school teaching as "persistence of whole-group instruction, teacher talk outdistancing student talk, question/answer format drawn largely from textbooks, and little student movement in academic classes" (p. 16). Such a pedagogy is driven by core beliefs in how students learn and the teacher's desire to live within the norms and expectations of the school. The structure of the school (isolated

classrooms, limits in time allotments, numbers of students) further limit the possibilities for change. Cuban (1982) remarks that the "remarkable, century-long perseverance of standard high school instructional practice is -- if anything -- a sign of resilient vitality rather than rock-hard rigidity" (p. 117). Goodlad (1983) points out that teacher's "formal and informal experiences...and the messages they receive from the internal and external context of schooling all conspire to reinforce the status quo. The cards are stacked against innovation" (p. 470). Werner (1991) demonstrates that "change is resisted because it threatens the stability and predictability of school cultures" (p. 15).

There are many cultural aspects that can act as barriers to implementation of the Standards. Within the literature, I found three such aspects that were significant to me. These are the notion of orderliness, the use of lecture to impart knowledge, and assessment techniques.

Orderliness.

When someone passes the doorway of a teacher's classroom, there is an immediate judgment made on the teacher by how quiet and on task the students are. Such judgments are made by fellow colleagues, principals, parents and students. An appearance of orderliness becomes of utmost importance to teachers. In fact, Lieberman and Miller (1984) have found that "no matter how

effective teachers are in the classroom, all that is ever really known about them in the general organization of the school is whether they keep their classes in line or whether the students are in control. Control precedes instruction" (p. 4).

The Standards challenge the teacher to dismiss this notion of orderliness. The standard of "mathematical communication" calls for student discussion, requiring small group activities where students must learn to "justify their own claims without becoming hostile or defensive" (NCTM, 1991, p. 58). Teachers will not only be required to sanction greater noise level in the classroom but they will also have to teach social interaction skills as well as cognitive skills.

As well, the problem solving orientation of the Standards requires that students work with a variety of tools. Students will need to move freely around the room to have access to computers or to share graphing calculators. Teachers can no longer expect students to sit quietly in rows, working in isolation with minimal movement in the classroom.

This is going to be a difficult norm to challenge. Goodlad (1983) found that teachers using alternative techniques "were aware of the desirability of having students participate in setting their own goals, making choices, solving problems, working cooperatively with peers, and so on. But these views were

tempered by conflicting ones having largely to do with maintaining control. Those time-honored practices that appeared to help maintain control won out" (p. 469).

Lecture.

Cuban (1982) and Goodlad (1983) found that teacher talk is the predominate activity in high school classrooms. This method is most efficient for transmitting a great deal of content information to large groups of students. Teachers are also able to keep control of the classroom, reinforcing an authority role and maintaining orderliness. Generally, teacher's impart knowledge about content and skills, assess students' acquisition of this knowledge and "fix" the student if the knowledge is not learned.

The Standards, however, demand a constructivist pedagogy. Teachers refrain from giving "correct answers" and instead facilitate discussion and encourage students to conjecture and validate arguments (NCTM, 1991). The idea is for the students to develop their cognitive processes such as reasoning, exploring, and communicating. This requires a radical change in expectations and beliefs of how knowledge should be taught. If a teacher attempts to "fix" a student's misconception by transmitting information, the student will gain content knowledge but may be denied experiences that can lead to the development of the ability to reason and conjecture.

Changing a teacher's beliefs about how and what knowledge should be taught is a monumental task in itself. At the same time, however, teachers must also learn to ask questions differently, develop appropriate tasks for exploration and create a risk free environment. This calls for radical changes to the core pedagogy of the mathematics classroom.

Assessment.

Schools have many stockholders involved in the process of organizing school culture. For the majority of the public (parents and non-parents), the role of the school is to "contribute to an efficient work force, provide employees who can read, graduate a steady stream of qualified applicants to universities, keep pace with schools in countries where we sell or hope to sell goods, and so on" (Goodlad, 1983, p. 468). The public feel they can most easily determine school effectiveness by issuing standardized tests (Goodlad, 1983; Romberg, 1993). For ease of administration, these tests are often multiple choice, with a focus on low level knowledge of content and skills. Consequently, the curriculum that gets taught tends to be content or skills specific (Goodlad, 1983; Lortie, 1975).

The Standards call for the assessment of such notions as mathematical understanding and disposition. Teachers are expected to include methods such as "evaluating journals,

notebooks, essays, and oral reports...evaluating classroom discussions including attention to students' mathematical problem-solving, communication, and reasoning processes; and evaluating group work, clinical interviews..." (NCTM, 1991,p. 110). No longer can the teacher rely solely on computer multiple choice test banks as a source for comprehensive assessment. Implementing the Standards would not only require a redesigning of assessment strategies, but also changes in the teachers marking practices. I have had mathematics teachers express to me that it is more problematic and time consuming to mark open ended questions than one-answer, closed questions.

Research on Implementation of the Standards

The studies on implementing the Standards at the secondary level are few in number and far from complete in describing the problems that teachers face. I initially came across three quantitative studies, one by Fagan (1991), another by Ghabban(1992) and a third by Crawford (1991), describing outcomes of the implementation of the NCTM Standards. Fagan surveyed 455 teachers about their concerns regarding the Standards. She categorizes these concerns into five categories and then finds positive correlations between these concerns and such factors as attending conferences, having a personal copy of the Standards and involvement in the curriculum development. While this study raises a large number of concerns it does not describe how these concerns come

about and how teachers deal with them (or don't deal with them).

The studies by Ghabban and Crawford reveal some disturbing attitudes and beliefs. Ghabban surveyed 125 high school teachers and found that 50% believe that in-service and pre-service preparation programs were "between weakness and great weakness conditions for facilitating implementation of the Standards" (p.702), and most teachers considered almost all mathematics instructional goals to be very important or important, but they felt that less than half the students achieved these goals. Crawford found that if an activity could co-exist with the present curriculum then two-thirds of the teachers would use it, and if an activity was contrary to the curriculum (as many Standards activities are with the B.C. mathematics curriculum) then only one-third would use it. These two studies show that there may be difficulties involved in the implementation of the Standards. These difficulties are deeply rooted in the cultural differences between what is suggested in the NCTM Standards and what is typically known as the traditional classroom.

Factors Influencing Teacher Change Towards Conceptual Learning in Mathematics

The qualitative studies on implementing the Standards identify factors that influence the success or failure of change. While the teachers involved in most of these studies are student teachers or elementary school teachers, the results provide helpful

insights into some difficulties that secondary mathematics teachers may experience.

Studies by Smith (1992), Eisenhart, Borko, Underhill, Brown, Jones, and Agard (1993), and Putnam, Heaton, Prawat, and Remillard (1992) reveal that despite being familiar with the philosophy behind the Standards "telling, modelling, and explaining pervaded the teaching... sometimes in ways that might have precluded meaningful student engagement..." (Putnam et al., p. 217). The teachers frequently felt the tensions between letting the students come up with their own meaningful constructions in mathematics and the teacher's desires to give the 'correct' information. The latter teaching style arises because of external factors such as time constraints and standardized tests.

The Putnam et al. (1992) study also shows that teachers with a hierarchical view of learning (mastering skills before attempting to solve problems) had difficulty accepting that conceptual understanding "is complexly intertwined with, rather than built on, computational or procedural knowledge" (p.219). Such beliefs make it difficult for the teachers to give up an instructional focus on facts and procedures.

These studies reveal many difficulties in the implementation of the Standards; difficulties arising from teacher beliefs and knowledge and external constraints. While I can identify with these

issues, I am not comfortable with the nature of these studies. In the Eisenhart et al. (1993) and the Putnam et al. (1992) studies teachers were basically given the Standards documents and "left to implement these changes" (p.215). Leinwand (1992) states that "substantive, lasting, constructive change advocated by the Standards occurs best when teachers are given adequate time and support to assume ownership of the proposed changes" (p.468). As well, we do not get to hear the "teacher's voice". Teachers are "the only adults who witness the dynamics of daily classroom interaction and have intimate knowledge of the subtle learning events that permeate the classroom environment" (Pine, 1992, p. 668). It is essential that the teacher's voice be heard in order to understand learning within the classroom context. And lastly, the researchers were able to gain some insight into the problems of implementation but left the teacher with nothing but a list of faults and shortcomings. The resulting sense of teacher powerlessness only exacerbates difficulties with educational reform.

Collaborative and Participatory Research Efforts

The studies mentioned so far deal with researchers doing research *on* the teacher. There are a few studies on implementing the Standards where the teacher works collaboratively *with* the researcher or the teacher *is* the researcher. Such studies provide a dialectical interaction between the teacher and the innovation as

opposed to having the expectation that the teacher adopt the innovation as is.

Lampert (1990) collected data on her own teaching of fourth and fifth grade mathematics classes. Her focus was to provide a safe environment where students may conjecture and argue to express their thinking. Lampert combined action research with interpretive social science. She conducted the action and collects the data, but the data was analyzed by educational psychologists, sociolinguists and mathematicians. Her work reveals the importance of "engaging students in authentic mathematical activity" and she recognizes the problem of "defining what knowledge students have acquired" (1990, p. 59).

My reaction to Lampert's work is one of awe. She has a Doctor of Education degree, works part time at the University of Michigan State University and teaches part time at an elementary school. I value her action research techniques but I feel that these techniques should be examined as they are used by "ordinary" full-time classroom teachers. I am particularly interested in how the two teachers involved in my study will make use of action research and what are their difficulties when employing standards oriented activities in their classroom. These teachers do not have masters degrees and are full time teachers in the education system.

Wood, Cobb and Yackel (1991) worked collaboratively with a

second grade teacher. Wood et al. describe the teacher's involvement:

The project teacher, in creating a setting that focused on the mathematical activity of her students, encountered major contradictions with her prior traditional practice. It was during these periods of conflict, followed by reflection and resolution, that opportunities for her to learn occurred. In addition, as a member of the research team, she had considerable opportunity to express her concerns and receive suggestions and support from the researchers as she reorganized her thinking. (p. 611)

I found the design of this study more compatible with my own research design in that an ordinary teacher is involved in the research. Her voice is heard and valued as she identifies conflicts or difficulties and then works through resolutions. However, I want to take this one step further and combine the works of Lampert (1990) and Wood et al. (1991). I will work with two "ordinary" teachers, and I will also be involved as a teacher researching my own practice. Such an arrangement reduces the inequalities that may exist between the teacher and the researcher.

Romagnano (1991) designed a project where he immersed himself into the classroom setting and worked collaboratively with another teacher. What makes this study even more valuable to me is that the context is the secondary classroom. I could find no other collaborative or participatory studies that discussed teacher change in the secondary mathematics classroom.

Romagnano and the teacher each taught a general (remedial) mathematics 9 class and discuss and compare their results. They found

three dilemmas to be pervasive in their struggle: "Ask Them-Tell Them", "Good Problems" and "Grading". The "Ask Them-Tell Them" dilemma stems from Romagnano's attempt to foster independent learning. He refers to the Standards: "Experiences designed to foster continued intellectual curiosity and increasing independence should encourage students to become self-directed learners..." (Commission on Standards for School Mathematics, 1989, p.128). The dilemma that Romagnano found is that if the lessons are structured to be open-ended and exploratory, the students get frustrated and disengage. Students' expectations are that lessons be directive with unambiguous explanations of procedures leading to completed tasks. In other words the students want to be told exactly what to do. This problem is similar to the findings in the Putnam et al. (1992) study. I have experienced this dilemma with my own remedial mathematics classes (Mathematics 9A) but to a lesser extent with my regular mathematics classes.

The "Good Problems" dilemma refers to the different views of what constitutes good problems. To the researchers good problems "contain lots of mathematics, and it takes time to explore lots of mathematics" (Romagnano, 1991, p. 132). Unfortunately, these students lost interest in these problems quite quickly, especially if correct solutions could not be found immediately. Romagnano compromises by shortening the length of the problems and providing more structure to the procedural tasks involved. This compromise is in contradiction to the goals set out

by the researcher.

The third problem was that of grading. Romagnano exclaims,

We wanted students to know that it was what they learned that was important, but we also wanted students to behave in class and engage in the lessons we designed. If we included behaviour in their single letter grades, then those grades, as indicators of achievement, would be confounded. However, if we did not include behaviour as part of students' grades, we would lose what little leverage we felt we had to influence their involvement in class. (p. 155)

These three problems reveal the realities behind implementing a curriculum or teaching style. What I value from this study is that the researcher was a full participant and expressed difficulties with which I, as a teacher, can identify. The research was conducted so that all who were involved learned from the study. There are, however, four issues that will be quite different in my own project. Firstly, the teachers in my study are teaching regular track mathematics classes as opposed to remedial mathematics classes. The attitudes and behaviours in a regular classroom can provide quite different reactions to instruction techniques involving the Standards. Secondly, the classroom aspect of my project starts at the beginning of the school year before the teachers own norms are established. This way the students do not experience a sudden change in instruction in the middle of the year. And thirdly, in the Romagnano study, the teachers had little experience with remedial mathematics students. The teachers involved in this study are familiar with the attitudes and actions of regular mathematics students. They are

able to draw on their previous experiences to help guide them through difficulties. And lastly, it is difficult to tell if the students would have eventually developed skills to be independent learners given more time with the researcher. The Romagnano study was only seven weeks long. This study involves students for a 6 month period, allowing for more time for change to take place.

An Environment for Teacher Change

The implementation of the Standards is undoubtedly going to present problems in terms of conflict in cultural norms and pedagogy. The design of this project must take into account what researchers have learned about teacher change. There are two major studies that represent two views of implementation of change. In the early 1980s a project called the Study of Dissemination Efforts Supporting School Improvement or (DESSI) revealed that innovations are often successfully *adopted* when there is administrative pressure and sustained support and teachers are motivated, not by the desire to improve practice, but by career advancement incentives (Huberman & Miles, 1984). On the other hand the Rand Change Agent study done in the early 1970s reveals that initial support from administrators helps initiate the innovation project but the most powerful attribute for successful change was teacher sense of efficacy; "a belief that the teacher can help even the most difficult or unmotivated student"

(McLaughlin & Marsh, 1978, p. 85) Also, the teachers tend not to *adopt* the innovation but *adapt* the innovation to suit their context. McLaughlin & Marsh (1978) conclude that for teachers "the learning task is more like problem solving than like mastering 'proven' procedures" (p. 87). The significant difference between the DESSI and the Rand studies is that the DESSI study looks at innovations that are tested and clearly defined (proven procedures) and the Rand study focuses on innovations that are seen more as grand ideas or philosophical changes in teaching style. The Standards represent a grand idea. They are more a vision than a specific innovation. Leinwand (1992) reflects on the Standards, "for many of us this vision represents massive, uncomfortable, teeth-pulling, getting-out-of-the-rut, heavy-duty change. It will likely entail discord, disequilibrium, dissension, discomfort, and even disgust" (p. 470). The Standards vision requires confrontation with existing cultural structures. The findings of the Rand study is, therefore, more relevant to my project.

Further research supports the suggestions that McLaughlin and Marsh (1978) make based on the Rand study. Fullan (1991) states that he "sees teachers and others working in small groups interacting frequently in the course of planning, testing new ideas, attempting to solve different problems, assessing effectiveness,

etc." because change means "a radical change in the culture of schools and the conception of teaching as a profession" (p. 142). Taylor and Werner (1989) state that successful implementation occurs "only when teachers have the opportunity to study the new curriculum, understand what changes are involved, discuss the implications with colleagues, and adapt the new ideas to suit local school conditions and the needs of different kinds of students" (p. 8). Shaw and Jakubowski (1991) add that "genuine change [in practice] must come within each individual teacher" (p. 13). In an analysis of the change process, derived from two separate studies, they have found evidence for six cognitive requisites.

For change to occur, teachers need to : (1) have a perturbation, (2) have a commitment to change, (3) construct a vision of what the classroom could be, (4) project themselves into that vision, (5) decide to make a change within a given context, and (6) be a reflective practitioner by comparing their practice with their vision. (p. 13)

Shaw and Jakubowski suggest that these requisites are vital to the success of the implementation of the NCTM Standards. In chapter three I describe how the three teachers involved in this project experience these requisites of change.

The Standards requires massive and complex change where teachers need opportunities to develop a shared understanding of the Standards vision, to develop means of implementation in a supportive, risk free environment and to observe and reflect on

the results of implementation in order to improve practice and the change process (Leinwand, 1992; Richardson, 1990; Romberg, 1993, Shaw and Jakubowski, 1991).

Collaborative Action Research

Since the early stages of designing this project, and as the project progressed, I felt that one way to establish an appropriate environment for discussion and reflection was the use of a collaborative action research model as a guide to the change process. The action research cycles should help the practitioner "go beyond the present constraints (to some extent at least) and to empower him or her to act more appropriately in the situation and more effectively as an educator. It should help the practitioner to realize a new potential for education action" (Kemmis, 1984, p. 8).

Action research involves cycles of planning, acting, observing, reflecting, and replanning. These are described in detail below, in light of addressing the conflicts with classroom culture. The role of collaboration will be revealed within each stage of the cycle where relevant.

Planning.

The planning stage begins with the identification of a research problem. In this case the problem would focus on how to implement the Standards or aspects of the Standards. The practitioners then reflect on the differences in beliefs and

assumptions behind the teachers' practice and the innovation. A collaborative group discussion can clarify the purpose and intent of the innovation and teachers can develop a shared, informed understanding of the changes that may take place and the possible cultural constraints on those changes.

The practitioners would then develop an action plan to address the problem. This plan is the result of "intelligent ideas" not "correct solutions" (McKernan, 1988, p. 194). Discussion with other teachers and academic specialists provides the practitioner with "alternative images" thus widening the possibilities for action (Shaw & Jakubowski, 1991, p. 19).

Action.

A key aspect of Action Research is that it is conducted *in situ*. It is "implemented on site, and it seeks to explain the phenomenological world view held by actors in the setting" (McKernan, 1988, p. 188). Since it is the classroom culture that may impede implementation it only makes sense to research the effects of the innovation within its actual context.

The planning stage is designed to allow practitioners to develop the best form of action to take. However, it is impossible to predict all the possible variables that will be involved in the implementation of an innovation and to predict the outcomes. Kemmis (1984) reminds us that "it is not until we begin to act, to

take the first action step in the context of a real classroom, that we begin to discover the constraints imposed, for example, by previously unquestioned habits of the class control" (p. 13).

Observation or Data Collection.

The action provides data from which the teacher may learn about his or her practice. The action research structure requires that observation be guided by the intent to provide a sound basis for critical self-reflection. The teacher researcher must design a method of data collection that will focus on the action, its effects, and the context of the situation in which the action must be taken" (Kemmis, 1984, p. 8).

Reflection.

Many cultural traditions are strongly tied to the beliefs and assumptions of the teacher and the school community (Hargreaves, 1989; Romberg & Price, 1983; Werner, 1991). Shared beliefs and values create the culture and the culture reinforces the shared beliefs and values. Richardson (1990) found that changes "were often dropped if they didn't 'work' for that teacher" which meant that the activity violated "the teacher's beliefs about teaching and learning" (p. 14). In other words, there is a mismatch between the innovation and the beliefs of the teacher.

The reflection stage in the action research cycle allows the teacher to "relate the activity's theoretical framework to their own

beliefs and understandings" (Richardson, 1990, p. 16). Initially the teacher may make adaptations to the innovation so that it may better fit the cultural setting. But after several cycles of planning, action, observing and reflecting and with the aid of critical discussion the teacher will eventually experience changes in his or her beliefs which can then result in an adaptation of the classroom culture (McCutcheon & Jung, 1990; McKernan, 1988; Shaw & Jakubowski, 1991). McKernan states that "teachers become not only critics of the curriculum but cultural change agents; they seek to bring about changes in schooling and curriculum, as well as in students' values and beliefs" (p. 193). Lovitt et al. (1990), Richardson (1990) and Werner (1991) stress the importance of discussion and critical reflection in the change process.

Replanning.

The replanning stage is similar to the initial planning stage except that at this point the practitioners have a deeper understanding of the problem at hand and can reformulate the problem and alter the plan of action for the next cycle.

Critical or Emancipatory Action Research

As stated in the beginning of this paper, the central theme of the Standards is mathematical power for all students. Michael Apple (1992) hails the "attempt to create a non elitist curriculum" and points out that the Standards "recognize that the entire

current curriculum excludes many children not only in mathematics but in so much else" (p. 412). There is an emancipatory interest to engage the student "not simply as an active rather than passive 'receiver' of knowledge, but rather as an active creator of knowledge along with the teacher" (Grundy, 1987, p. 101).

Our present mathematics classrooms is set in the culture of a hierarchical school system. In order to create an environment where students can become emancipated learners it is first necessary for teachers to liberate themselves from the existing cultural constraints. It is for this reason that *critical* action research is an appropriate vehicle for implementing the Standards. Critical action research revolves around the notion of praxis: "the emancipatory interplay between action and reflection"(McCutcheon & Jung, 1990, p. 147). This critical perspective involves a "concerted effort to reexamine the taken-for-granted and institutionalized constraints of schooling such as scheduling, compartmentalization of subject matter, and discouragement of rational dialogue between teacher and student" (McCutcheon & Jung, p. 147). It is with this focus that teachers must undertake the reflection and replanning stages of the action research cycles.

There is another important condition for emancipation.

Teachers must have ownership over the research problem. Many innovations are imposed on teachers in a "top-down" fashion. Richardson (1990) points out that when teachers are not developing their own research problem and have little control over the implementation of an innovation they focus on external forces that create constraints and "ignore questions related to their own beliefs, understandings, and activities" (p. 16). Collaborative action research allows the practitioner to design their own problem in view of the context of their classroom. Academic specialists and other teachers are there to provide an opportunity for discussion about alternative conceptions and activities as well as provide a supportive environment for critical dialogue.

Action Research Verses Reflective Practice

There is one component of action research that is significant in distinguishing action research from reflective practice. Pine (1992) states that teacher research is seen as "deliberate inquiry, not off-the -cuff reaction. It needs to be thought through systematically and pursued methodologically, and reported in forms that are usable by other teachers and educators" (p. 657). Similarly, Ebbutt (1985) explains that "reports ought to be available for some form of public critique....if this condition is not satisfied by the participants then no matter how personally and professionally valuable the exercise is in which they are engaged, it

is not action *research*" (p. 157). And McKernan (1988) states that "the key idea is that each classroom or work space becomes a laboratory for empirically testing hypotheses and proposals that are the planned and implemented curriculum" (p. 174). These articles influenced my approach to the development and facilitation of this project. I wanted to go beyond being a reflective practitioner. Systematic inquiry and reports on that inquiry were an important aspect of the action research process during this study.

Conclusion

In an introduction to a series of articles on educational reform, Secada (1992) also discusses the role of teachers in educational change. He ponders,

What I find most interesting in reading these contributions, however, is the sense of challenge that is conveyed. Granting that reform will take time and that the changes that are being called for represent some radical shifts in how mathematics gets taught, I find myself wondering about what compromises will take place as the vision for reform is accommodated to the realities of current practice and how that vision will be enacted over the next generation of students. (p. 406)

Secada recognizes that there is a large gap between the theory of educational reform and the actual practice of that reform. We have seen evidence of this gap in the studies on implementation of the Standards. It is for this reason that it is important for teachers to learn from their practice and for educators to learn from teachers as reform is

implemented in classroom and schools.

Chapter 3

Research Approach

The Commission for Standards for School Mathematics (NCTM, 1989) states that "problem solving should be the central focus of the mathematics curriculum" (p. 23). Through problem solving, students can build on prior knowledge to develop new concepts, learn in a context that they can relate to, and take ownership of the mathematics they learn. It is fitting, therefore, that teachers use a problem solving approach to learn about teacher change. The teachers can reflect on and find solutions to their own problems as they try to implement the standards. McKernan (1988) states " Action research has enjoyed a new rejuvenation because of recent curriculum landmark studies suggesting that school-based *problem solving* [italics added] approaches to curriculum change are more likely to be successfully implemented than large, federally funded, central initiatives" (p. 179). An action research approach encourages the same reflective, problem solving process that students should be learning in mathematics classrooms. As well, a collaborative action research format provides some structural guidance for teachers doing research and allows teachers to make changes in a supportive environment.

The study reported here began in May, 1994. I first sent out advertising notices to every secondary mathematics teacher in my district. After receiving no responses, I phoned the mathematics

department head at each school to ensure that mathematics teachers received the notice. In a district with approximately 25 secondary mathematics teachers, there was not one who was willing to commit to the project.

Finally, I contacted the district mathematics helping teacher from a neighbouring district and she gave me the names of two teachers to try. John, a mathematics teacher who also teaches science was the only one to agree to join the project. At about the same time, I mentioned the project to a friend, Shirley, who also teaches in this neighbouring district. While Shirley considers herself a science teacher, she often gets timetabled to teach mathematics classes and had expressed interest in the Standards. She was very eager to be involved in the project.

The Process

The change process in this project is modelled on Shaw and Jakubowski's (1991) six cognitive requisites for change. Teachers must

(1) have a perturbation, (2) have a commitment to change, (3) construct a vision of what the classroom could be, (4) project themselves into that vision, (5) decide to make a change within a given context, and (6) be a reflective practitioner by comparing their practice with their vision. (p. 13)

The three of us had already discovered a perturbation in our practice and had come to the study with a commitment to change. I have already described my reasons for instigating the study. I will now give some background on John, Shirley and myself.

Nancy.

I have five years of mathematics teaching experience at the grade 8 to 12. I have never taught any other subject. I started my Masters in Mathematics Education in my third year of teaching. I have also attended NCTM and BCAMT conferences every year. I had been exposed to the philosophy of the Standards in University and at conference workshops but I had never actually read the Standards until I did an independent course for credit for the Masters degree. I have always been enthusiastic about becoming a "non-traditional" mathematics teacher, but I have met with a great deal of frustration and have felt very alone. During the project I taught two Mathematics 9 and two Mathematics 10 classes. Each class is about one hour and twenty minutes long and the course runs for the whole year. The secondary school I teach at has a predominately middle class, European student population. I worked part time (57%) so that I would have every other day off to take a university course, type transcripts and prepare for the meetings.

John.

John is an eighteen year veteran teacher. He has taught industrial education, mathematics and science and says he feels equally comfortable in all three. At the time of the study, John was working on a Masters Degree in Curriculum Studies. John is, and always has been, very excited about improving his teaching. Two years prior to the study

John had tried getting his mathematics students to write journals and felt his students were not successful. He was particularly interested in trying this again. Although John had not yet read the Standards, one of his first comments about the Standards was "It will be very useful in that it will give teachers a view of alternate ways of teaching Mathematics, not different Mathematics to teach. The documents break from the normal practice of lecture-practice-quiz-test sequence". John taught Mathematics 8, two Mathematics 10 and a science course. His school is on the semester system and the student population is very heterogeneous where the majority of the students are of East Indian origin.

Shirley.

Shirley is a science teacher of seven years. She started teaching junior mathematics courses three years prior to the study and knew that she would be teaching mathematics during the year of the study. In her science teaching, Shirley stresses making connections and having hands on experiences. She feels it is important that her students have an understanding of the science concepts as opposed to just memorizing. Shirley is comfortable with this in science, but not in mathematics. In fact, Shirley is generally uncomfortable teaching mathematics courses. In order to improve her practice, Shirley has attended mathematics conference workshops that promote the Standards but she had not read the Standards herself. At the start of the project Shirley writes

"Intuitively, the Standards' aims of [helping] students reason, conjecture, solve problems seems appropriate. I would like an opportunity to steer my students in these directions while having discussions with other teachers." Shirley's school is on a quarter system where two courses run in each quarter. Shirley taught Mathematics and Science 8 as a combined course in the first two terms as well as two Science 10 courses. Her school is about 50% Indo-Canadian. Her students generally come from lower to upper middle class homes.

The actual project began with Shaw and Jakubowski's third requisite for change in mind: constructing a vision of what the classroom could be. The first group meeting took place at the end of June, 1994, at which time Shirley and John were given the Standard documents and were asked to start a journal for reflection. The intention was that we would construct our own visions and refine these visions through discussions at future meetings.

We met again on August 30 where we not only discussed our understanding of the Standards documents, but also decided which aspects of the Standards we could possibly incorporate into our practice. This was how I interpreted Shaw and Jakubowski's (1991) requisite four, "projecting themselves into that vision", involving the "personalization of the vision whereby teachers can see themselves implementing a curriculum in the manner envisioned" (p. 14). We chose what change or changes we would like to make and made plans for incorporating these

changes. Thus, we completed requisite five. From September 1994 to February 1995 we carried out requisite six by reflecting on our practices in terms of what we had planned to do, discussing merits and faults in the change and making new plans for future changes. We did this by meeting every two weeks after school at either John's classroom or Shirley's classroom (see appendix 1 for dates). We generally worked on our own and then reflected on our ideas and received feedback from each other during these meetings. All meetings were audio taped and transcriptions of these tapes were the primary source of data for this study.

Action Research Component

I have not yet mentioned the action research component of this study. I felt that action research would provide a structure through which we could achieve the six requisites of change. I gave Shirley and John a copy of Carson, Connors, Ripley and Smits' (1989) Creating Possibilities: An Action Research Handbook, so that they could familiarize themselves with the action research process. The Carson et al. handbook uses the model described by Kemmis and McTaggart (1988), and provides an outline for beginning an action research project (p. 3). We spent some time during the August 30 meeting discussing this process. John and Shirley glanced over the handbook but voiced that they were still not sure how to develop a problem statement and design a plan for change. I created two forms (see appendix 2) that

offered outlines for such a plan. Shirley and John were given the option of using them. They both liked the second form and decided to use it for their first cycle in September.

From September to February, I had expected all of us to put our plans into action, collect data, reflect and revise our plans. In reality, John and Shirley focused mostly on implementing their ideas and did some reflection, but the action research model was forgotten. I made one attempt, on November 30, to revitalize the action research process. We discussed what our focus problems were and again I suggested a format for making a plan.

Meanwhile, I was unable to make sufficient time to appropriately analyze the meeting transcriptions and journal entries until I stopped collecting data in February. It was through in-depth analysis that I came to better understand the reasons for the difficulties we felt during our action research process.

My role in this study was that of full participant. I was one of the teacher researchers and I was the group's academic contact. Ted Paszek (1989) states,

Collaboration with others is an important aspect of action research. An outside collaborator from the university is ideal because then there is someone who can take the time to do the review of literature and supply any readings that are needed to the practitioners. (p. 87)

However, as Dennis Thiessen (1989) points out, status, influence, expertise, or authority can create an inequality that can "threaten the

principle of shared power embedded in collaboration" (p. 158). While I recognize I could not eliminate this inequality, I felt I could place myself on a more equal level by taking the same risks as the other teachers.

To further ensure the collaborative nature of this project the teacher researchers, Shirley, John and myself, had full control over what our focus questions would be and what data we would share with each other. John and Shirley were fully aware of all aspects of the data that was collected by me. Hannay (1989) and Romagnano (1991), suggest that analysis also be discussed as an ongoing and interactive process. I was able to facilitate reflection by reminding John and Shirley of previous decisions or comments that we had made, but I found that I was unable to carry out an in-depth analysis of the data until our meetings ended.

My Role

I had three roles in this project, that of teacher researcher, principal researcher and facilitator. As teacher researcher, I was involved in an action research cycle that focused on my practice as a teacher. I kept my own teacher journal for reflection on my practice. I discussed my plans, results, reactions and conclusions with John and Shirley just as John and Shirley did the same with me.

As a principal researcher I was involved in a larger action research cycle that focused on our experiences as a collaborative group. Data included audio tapes of the group meetings, journal entries made by the

three teacher researchers and field notes on the journals, meetings and on any personal insights into the project.

As facilitator, I arranged meeting times and provided information about the Standards and action research, and guided some meetings so that we would remain focused on the action research model. Also, as I read John and Shirley's journals and transcribed the tapes from the meetings I provided feedback that prompted further reflection and discussion.

It was often difficult to separate my role as principal researcher from my role as facilitator when making decisions. Overall, I tried different "actions" at various meetings and reflected and learned from the group's responses.

Data Analysis

Analysis of my data required transcribing every meeting. I then sifted through the transcriptions, teacher journal entries and field notes and pulled out any events that were related to either the Standards, our actions, or the action research process. I typed descriptions or quotes from these events and numbered them according to where they could be found in the original documents. I then reviewed the list of events for possible "domains". Spradley (1979) describes domains as "any symbolic category that includes other categories" (p. 100). I made a list of domains and coded each with a letter. See appendix 3 for a complete list of domains.

Spradley (1979) suggests that the ethnographic researcher then "test these hypothesized folk categories (domains)" (p. 120).

Throughout the study, as I transcribed tapes of the meetings, I often asked John and Shirley questions about events. However, my analysis between meetings was superficial, at best. I discuss this further in chapter four and five.

I created a table with all events coded by domain and used the computer to sort the data. Those events that fell within two domains were duplicated and coded twice. Once the events were sorted by domain, it was clear that some domains were more significant than others. This was evident by the number of events that fell within the domain as well as the personal interest I had in the domain. I decided to first focus on domains related to action research. Before eliminating data from the other domains, I reviewed the events from other domains and recoded some that I felt could remain in these domains. The remaining domains were mechanics of action research, collaboration and fear of trying new things.

To further analyze the data with this area of focus, I reviewed all transcriptions, researcher notes, material given to me by John and Shirley as well as my own teacher journals, to add any further significant events that I missed the first time. I then dated all events and arranged them in chronological order (See appendix 4). Finally, I made a compacted summary of events in order to get a better look at the whole

picture. As I wrote chapter 4 the process of analysis continued. After describing the unfolding events I became aware of five different themes which I will later discuss in Chapter five.

Spradley describes two types of domain analysis. "Surface analysis" (p. 133) describes all domains and looks for relationships between them, thus giving a holistic cultural view. "In-depth analysis...studies a single domain intensively" (p.134). Spradley suggests that ethnographers "adopt a compromise: study a few, selected domains in depth, while still attempting to gain a surface understanding of a culture or cultural scene as a whole." The analysis process that I have done has allowed me to superficially observe the entire cultural environment and then focus on a few domains. I was able to analyze relationships between the domains as well as within the domains.

Summary

This project is an action research project. I made an initial plan for how the project would proceed but soon discovered that my plan did not fit the needs of the other teachers involved in the project. As I reflected on the meetings (outcome) I revised my plans for how to conduct the next meeting (input). The point of the design of this method of research is that input and outcome are interrelated. The project was thus an evolution. The themes that I discuss are also evolutions. An evolution has no beginning and it has no end. For practical purposes, I stopped collecting data in February. This did not mean the processes

stopped. Therefore, I can not make final conclusions about what we discovered in the process, I can only make suggestions for improvements on my next project which will form another action research cycle.

Chapter 4

The Story Unfolds

I have briefly described the intent of using action research as a "vehicle" through which we may implement the NCTM Standards. In Chapter 3, I point out that the action research process did not proceed as I had expected. I will now describe the attempts I made to guide Shirley and John in using action research. These attempts, labelled "guide-posts" were initiated by me as facilitator. I will describe the actions that each of us took in relation to these guide-posts and I will allude to themes as they emerge. Discussion and clarification of these themes however takes place in chapter five in order to impress on the reader the revelations as experienced.

Guide-post 1: The Reconnaissance Process

Before our first meeting in June, I gave John and Shirley five written questions to think about regarding their teaching practice.

These were:

- 1) What aspects of your teaching style do you like?
- 2) What aspects of your teaching style do you dislike?
- 3) What kind of changes would you like to make?
- 4) Have you read the Standards or about the Standards, if so, describe what you read and what you understand the Standards to be.
- 5) Try to summarize your "philosophy" of teaching.

Nancy's responses.

I began this process as part of an independent study course on the Standards. Therefore, I wrote several pages. For question three, I answered,

I would like to explore ways to teach concepts relationally. I want to avoid giving students rules without reasons....

I would like more exciting lessons....

I would like to collect some data on whether my students are all

learning to their full potential with my system.

The first statement was to be my guiding force for the remainder of the project. I did not reflect further on the other two statements.

John's Responses.

John responded with one typed page plus he expanded on some of his points during the June meeting. His answer to question three was,

- allow for more individual student choices
- make students become more responsible for [their] own education
- make all subjects more enjoyable, fun
- involve parents more

John also stressed in his journal and in the meeting that he didn't like assigning drill questions from the book.

Shirley's responses.

Shirley did not have answers written but did share with us that she likes to provide concrete experiences for math learning and she wanted to improve discussion so that the concrete experiences are better linked to abstract ideas.

Summary and Reflection.

Clearly, as can be seen from this meeting, all three of us talk and write about making changes in our practices. We had a perturbation in our practices and were making a commitment to change.

Guide-post 2: Constructing a Vision

I asked Shirley and John to spend the summer reading the Standards writing down any comments or thoughts about them. During

this time we were to look for activities or changes that would be "do-able". We then discussed these at the August 30 meeting. I also gave Shirley and John each a copy of Creating Possibilities: An Action Research Handbook by Carson, Connors, Smits & Ripley (1989), to read over the summer.

John's vision.

John spoke first at the August 30 meeting. He did not have any written responses to the Standards, however the following is part of what he shared with us at the meeting,

A lot of the Standards, when I read it, when I read the stuff on assessment, I didn't really read other parts, the curriculum oriented parts, so I quickly went to p. 189 and started reading because the assessment and evaluation of what we are doing is going to be a contentious issue as teachers start trying to do this stuff. And...a lot of this has to do with kids understanding mathematics, not being able to just do skills. So, I want my research to focus on that understanding. I tried something, three years ago, that I didn't like when I tried, because it didn't work.... having the students write journals. And it was just, it just didn't work. Because the kids did not know specifically what to write. And it was so broad, my questions that I asked in the journal.... But I might have a better handle on it the second time around and this in between reflection.

John then described a basic plan for incorporating the journals into his mathematics classes. Implementing student mathematics journals continued to be John's focus for his action research plan throughout the project.

Shirley's vision.

Shirley, had nothing in writing about the Standards. She said at the

August 30 meeting,

Well, I've just started looking at these Standards and my first initial reaction was to just close them up and put them away and forget about it. They are way too daunting. Intuitively, what I am reading, I agree with.

Shirley admits to having only just started reading the Standards but I was surprised at how much she had learned so far. She talked about interests in several areas; whether or not to teach fractions in grade 8, problem solving, reasoning or conjecturing, communication, making math more applicable, learning to teach differently, assessment and promoting mathematical discussion amongst students. At last she nervously laughed and said "I don't know what I'm doing!"

Nancy's vision.

I spoke last. I had read the Standards from cover to cover, writing several pages of notes and thoughts. It is possible that I was more motivated to read and write at this point because my reflections were to be evaluated as a component of independent study course. At the August 30 meeting I shared my interest,

I'm concerned that [students] understand the importance of understanding the concept for example, before they just start drilling it, or start trying to get exercises done.

And later I outlined my plan for achieving this,

I want to have more activities that are going to develop an understanding....And then from there, leading in to the exercises that we have in the book....Now in order to keep them from just getting the exercises done, I have to do a second thing and that is to have what I am going to call "open questions" [later, we call

them reflection questions]

I described the types of activities I might do and gave examples of the types of questions I might assign.

After I told the group about my plan to focus on activities and reflection questions, Shirley then said,

These reflection questions look interesting to me....Just sitting here, I want to... just follow along with what you guys are doing and that's pretty good to me.

John and I supported Shirley in doing this. Since Shirley had expressed feelings of being overwhelmed with reading the entire Standards volumes, I suggested that she now read only the parts that pertain to her ideas and think about what she could do in the classroom.

Summary and Reflection.

As principal researcher and facilitator, I was concerned that John and Shirley had not read more of the Standards and had not written down their reflections. I was pleased, however, that both were developing ideas for their focus. It was becoming apparent that our discussions were becoming very important as we explored the Standards. By verbalizing our reflections on the Standards we seemed to validate our own understandings as well as add to each other's knowledge. For this reason, I decided not to judge John's and Shirley's lack of documentation as a drawback and proceeded.

Guide-post 3: Creating a Plan for Change

August 30, I also presented "action research planning sheets" (see

appendix 2) that Shirley and John may use to guide their planning. We agreed to write up our plans at home and discuss them at the next meeting, September 8.

Nancy's plan.

In fact, I had created the planning sheets as I developed my own plan, prior to the August 30 meeting. I felt I should go through the process of developing a plan before I had John and Shirley do their plans. The following is my description of the process.

Ok, now I'm kind of a step ahead of you guys because I am trying to figure out what's going to be the best way of doing things. So, I started thinking about what I would like to do for a plan and then I wanted to get some kind of concrete way of getting this down and getting what you guys were going to do down, so I ended up making this planning sheet. I've got two different kinds because I felt that one of them wasn't really serving my purpose. This one talks about the problems. I had problems or concerns and I thought no, we really should be focusing on one thing but then my second way of doing this, I went back to thinking about problems and concerns which would then lead to an idea of what we are going to do to take care of these problems. And how are you going to get data collection. But the way I need to set up, I prefer this (the second planning sheet) method. And you guys can either fill these in or make up our own title and what you are going to do. What I felt I needed to do is have a plan. I've come up with a couple of activities that I want to do...and there's a whole bunch of problems that these activities are going to address....So, It's not that I'm looking for a single problem and I'm going to solve it with a single activity. I felt for me it was going the other way around. And that's where I like this second [sheet] better.

The first planning sheet that I had developed started with the "problem" and then called for activities that would address the problem. The second planning sheet started with an activity and then listed the

“problems” that it would address. I had chosen two activities that addressed several “problems” and so the second format was more useful to me. I was uneasy with this format because it was not consistent with the examples of developing a plan in the Carson et al. (1989) action research handbook, where the “research problem” tends to be the driving force. However, for me, using the activity that I wanted to implement as the driving force, proved to be a more comfortable means to get my thought on paper.

I completed two planning sheets (as shown in appendix 5), one for implementing “reflection questions” and one for implementing concrete activities. The nature of my classroom research problem was captured by the problems I felt the activity would address. For example, in my reflection question plan, I wrote:

Problems that the plan will address:

- Promotes mathematical connections
- Promotes use of mathematical terminology
- Promotes reflection on learning

And the data that I was to collect would consist of student work which I would share with John and Shirley, and my own journal reflections. I was not clear then (and I am not clear now), how the data would answer whether or not I addressed my problem. My feeling was, I would worry about that bridge when I crossed it. In fact, I never did concern myself with this until much later in the project.

John's plan.

John did not have his plan written up for the September 8 meeting, but he did have a rough draft of his first student journal question and he wanted feedback on it. On September 21 John faxed me his written plan which also followed the second format that I had provided. It focused entirely on the use of journals in Mathematics 8, 9 and 10 (see appendix 6). The problem his plan would address was stated as,

Keeping track of students "understanding".

Encouraging students to reflect and take responsibility for their math learning.

He also had student work and teacher journal reflections as his data source and he did not document how he would analyze his data.

Shirley's plan.

Shirley was even more vague in making her plan. On September 19, she wrote a journal entry in which she stated,

I have started with the measurement unit because it is easier than other units to implement my plan of

- (1) developing reflection questions
- (2) continue to use manipulatives and real-life examples and problems
- (3) improve discussion [linking concrete activities to book exercises]

Shirley did not write about any details as to how she was going to achieve this or what she would do for data collection and analysis. The remainder of the journal entry focused on frustrations with getting new students, concerns about a gifted student, what content she will cover

and how this content relates to a corresponding science unit. At the September 8 meeting, Shirley did discuss concerns about doing reflection questions and collecting data on bridging discussions. We settled the latter problem by agreeing that I could come to her class and make observations on the discussions.

Summary and Reflection.

I had thought that by giving John and Shirley the Carson et al. Handbook on action research and by providing them with a planning sheet, we would all be able to design plans and begin our action research. In fact, John and Shirley had little time to read the handbook as well as the Standards, and would naturally find it difficult to internalize an understanding of these authors. Aware of this, I decided to struggle through making an action research plan first, so I could use the experience to give John and Shirley assistance and guidance. It was at this point I started to feel they needed more knowledge and expertise from me about action research. I had not anticipated that the handbook would be insufficient guidance.

In addition, when Shirley did not have the time to prepare written plans right away and John's plan was very brief, I wondered about setting deadlines for preparing their plans. As researcher, I began to feel the tension between my overall research needs and our individual needs. The question of how much structure and who was responsible for such discipline had not occurred to me.

John and myself had stated "focus problems" that were concerned with student outcome. We were unaware at this time that data collection and analysis would become an issue for us. The relationship between problem and data was murky at best.

Guide-post 4: Reflections

My intention for the September 29 meeting was that we would reflect on what happened (in terms of our plans) and make revisions to our plans.

John's reflections.

The September 29 meeting began with John answering our questions about details of his actions. We then discussed some ideas for extending student writing about classroom mathematics to writing about mathematics they find outside the classroom.

Nancy: Right, I think that's a nice start. I am just thinking about, you are talking about bridging to stuff outside the classroom. So, are you thinking of doing this for a while and then one day specifically say "think of some things outside the classroom"?

John: Yeah, where do you use math outside of the classroom. And in all the math that you have taken so far, can you see any application outside the classroom? That could be a hard question.

Nancy: Because they are not applying it. Especially grade 10.

John: No, they are not. How do you apply math 10. Grade 8 is easy....So, they are going to have to be helped along with that. Because connecting it to outside is really connecting it to mathematics thinking outside. Not specifically factoring trinomials.

Nancy: They might need a long time span to keep an eye on what is happening. Like maybe, instead of saying "write this in your journal", say, "this week we are going to start looking at things outside the classroom and at the end of the week we are going to do a reflection on it. So, keep an eye on things. Just jot down notes whenever something comes up".

John: Yeah, That would be a good plan.

Shirley: And maybe have a master list that you can sort of add to. A poster up that you can add to during the week a bit. During the class.

John: I like that. That would be good in any math class because then you could start to make...

Shirley: And other kids can sit and look at it and it allows for percolation.

And we continued to brainstorm ideas related to the development of John's student journals.

At one point I asked John if he was comfortable with the marking scheme that he had developed for the journals. John replied,

Oh Yeah (quite assuredly), well, oh, yeah (less assuredly), it's very difficult to mark. I am finding that scheme, one to four, difficult. I am finding it problematic in that the difference between 3 and 4. It's easy to tell a one, a two and a three, but what is the difference between a four? If a three is everything is done just right, what is a four? So I am having trouble with that.

It took us some time to clarify exactly what bothered John about the scheme and then we discussed and examined the scheme for fifteen minutes before we discovered what we perceived as the error. The following conversation is only a small part of what transpired.

Shirley: This says for level 4 "goes beyond the requirements of the

problem". I thought your question was how to decide between a 3 and a 4.

Nancy: How to give the 4.

John: How to feel comfortable giving a 3 when they have really answered the question.

Shirley: Well, "goes a step beyond the requirements" and maybe that's something that's not comfortable.

Nancy: Maybe that should just come out.

Shirley: Maybe we would feel that it is not fair. I think, for me, it depends on where they are in the learning of it....

Nancy: You know what bothers me about this, is that in order to give 4 marks, you have to do all this beyond this- It's like level 4 is actually two notches above level 3, instead of one notch above level 3. Because, level 3 doesn't say "has everything there". There is no level that says "has everything there". There's only a level that says missing a couple of things and the next level says has everything and a little bit more.

Shirley: Well this one says does not go beyond the requirements of the problem.

Nancy: But it also says "but missing an important one or two"

Shirley: So what are the requirements. Then, that's a contradiction.

Nancy: Yeah! So it seems to me that us-

Shirley: But you can have the requirements without being absolutely clear, absolutely coherent, absolutely unambiguous and absolutely elegant. Right?

Nancy: But there isn't a level in here where you have got all the requirements and you have been clear and all that sort of stuff but you didn't go beyond.

Shirley: So, this is quite different. Going beyond is inherently different from being coherent, unambiguous and elegant. It's different from communicating effectively. Actually, that's the difference isn't it?

Nancy: It's like a step above it.

Shirley: That's right. And almost level--

Nancy: And I think there should be a fifth level rather than--

John: It should be a bonus mark or--

Nancy: Either a bonus mark or make it out of five. And still give--

John: Then they can get 4 out of 5 which is 80%.

Nancy: Yeah. Which is a little bit nicer.

John: Better than $3/4$.

It was not unusual for us to take time in a meeting to help each other clarify issues about our plans. John changed his marking scheme to accommodate his discomfort. This was the "replan" of his original plan. However, John did not revise his written action research plan; the replan recorded in the transcriptions was never written.

Nancy's reflections.

I began the September 29 meeting by sharing with John and Shirley my students' answers to my first few reflection questions. We made several comments about good answers and bad answers but we did not attempt to analyze them for use of mathematical terminology, improved mathematical connections or student reflection on learning. Yet, these

were supposed to be my focus problems for using reflection questions.

Instead I discussed how I was frustrated in keeping up with marking, following up on my feedback to the answers and getting students to hand in their answers. At one point I exclaimed,

I have been feeling scattered last week. Like I haven't had time to, I actually did collect reflection questions today, but it was like half the kids didn't know what they were going to hand in. They have done a couple of them in their book already and I added to it and then I had to remind them of what I had already done. In fact, I had even forgotten that I had already given them some. So, I feel like the whole idea is getting disorganized even though, then when I look at what I am getting I really like what I am seeing and I am very clear on what they understand and what they don't understand and maybe, partly, I am frustrated because they don't understand it and then I am thinking "Oh God, So what am I going to have to do now?"

Shirley then paraphrased for me, stressing that despite all my frustrations the benefits are very important to me. Again, we spent time clarifying the nature of the classroom events. We also explored some of the causes of students' lack of understanding and by the end of the meeting, I was ready to revise my plan to adjust to my need for organization. I decided I needed to give the students reflection questions every day so that they would become part of the daily routine. Two weeks later, before the October 18 meeting, I made revisions to my written plans, using the same planning sheet (see appendix 5). My revision pertained only to the action that I would take. I did not change my data collection component.

Shirley's reflections.

Shirley, still, did not have a specific plan for addressing her problems. She had been sick and was busy with accreditation and had no preparation time in this quarter. She did, however, share with us some activities that she tried in the last two weeks. She gave her grade 8 students an area/perimeter problem from the NCTM Standards (1991, page 28), had her gifted students do a cooperative measurement problem, and tried to encourage all her students to "prove" their answers. Shirley described her feelings about doing these activities,

And I was really surprised how hard they worked at it. And how many different possibilities that they came up with....One thing was, that I found that I got, when they came up with really strange shapes, there was a point, there with the new [learning assistance] teacher, and I got intimidated by this teacher being in the room. And going into unfamiliar territory. And trying to explain things that I hadn't explained before, and recognising that I hadn't covered some material that I probably should have before I have this problem in the first place. So the start of it went well. And then it was, I can't do this anymore!! I'm not willing to take the risk right now...So that was a bit frustrating, but on the other hand it was very enlightening.

We expressed empathy with Shirley's experiences, pointed out some positive aspects of what happened in her classroom and provided encouragement to continue taking risks. Shirley's comfort level with Standards activities were beginning to be a predominant source of reflection for her.

Summary and Reflections.

By the end of September, I was pleased that John and I had written

plans and had even discussed revisions to these plans. John and I were impressed with the activities that Shirley was implementing in her classes. I was concerned at this point, that Shirley had not yet written a formal action research plan. I felt this was important because I had read that the difference between teacher research and "reflective teaching" was documentation of results made available for scrutiny (Ebbutt, 1985). I was beginning to struggle with whether or not I should insist that Shirley document her plans, actions and reflections.

All three of us reflected on and discussed the mechanics of implementing the plans. Shirley also reflected on feeling comfortable. We were not yet concerned as to whether or not the "data" (student work and our own reflections) were helping us make any conclusions about our chosen focus problems. Instead, our discussions helped us clarify what happened in our classroom as we carried out our plans. In turn, this helped us make changes in our plans to better suit our needs or those of our students. For Shirley and I, discussion also helped validate our feelings of fear and frustration and provided us with support and encouragement to carry on.

Although Shirley was doing a number of activities in her classroom, and was becoming more comfortable with these activities, she berated herself for not doing more than *one* set of reflection questions or for doing only *one* manipulative activity. As I analyzed these feelings in-depth, I came to realize that readiness may have been an issue

underlying our styles of approach to the Standards. Could it be that Shirley was at a different stage of readiness than I and therefore found it more difficult to focus on fully implementing one activity?

Guide-post 5 - Reducing Formalized Guidance

As I mentioned earlier, I was beginning to struggle with just how much structure I should provide. I was worried that too much structure would debilitate the collaborative nature of the project. Therefore, during the October 18, November 3 and November 17 meetings, I chose not to emphasize action plan revisions. Rather, I wanted to allow the meetings to unfold. Consequently, for this time period, we reflected on what was going on in our classrooms, clarified understanding of what happened, and encouraged each other to continue.

Nancy's accomplishments.

Within a couple of weeks of my October 17 plan revision, it became clear that I could not keep up with giving feedback to daily reflection questions and each question would raise issues that required discussion. I was feeling overwhelmed by the demand for time that these questions required. Finally, at the November 17 meeting I verbally declared that I would try to collect them once a week on a given schedule. This would cut down on marking, give students a better opportunity to redo poor responses and give us time to discuss the responses.

During the October 18 meeting I shared an activity that I had

created for introducing the Solving Equations Unit. This activity required students to think of an equation as a teeter totter, with the equal sign at the balance point. A box represented "x" and dots represented numbers. Students were guided to find out what one box was worth by removing dots from each side or dividing boxes and dots into groups. (see appendix 7 for an example).

I developed this activity to address my focus problem of promoting deeper understanding (although I never did analyze this effect). When I shared the activity at the meeting, John and Shirley liked it so much, they decided to adapt it to their own classrooms. Intuitively, we felt that students liked the teeter-totter analogy. We often referred to this activity when encouraging each other to continue implementation of the Standards.

John's accomplishments.

John made no revisions during this period of time. He seemed content with his results and shared some of his students' journals. Although I had decided not to force the action research component during these six weeks, I made a small attempt to suggest that John move on and try other things,

Nancy: Now it's 5:00. Why don't you tell us quickly what , now you are reflecting back at this point and you are looking forward to what changes you want to make or what you want to do. What direction to take.

John: Right now I have only written a journal that sort of reflects on how far the students have got. And also when I did it a long time ago. It's kind of, that's also part of this obviously.

Nancy: So you are going to change what you are doing at all? Or are you going to keep working on what you have got in place?

John: Well, I am going to keep working on what -- cause I -- when you look at these, these are really neat. I enjoy looking at these. Because they are so cool.

Nancy: You were telling me on the phone that they have gotten so good at it now, you need something else. Or something - (John is showing me some students responses). Yeah. They are very complete.

However, I recognized that while I felt that John might try out a new plan with a new focus, he wanted to enjoy his success. The important role of the meetings in John's action cycle became even more apparent early November. In the November 3 meeting, I asked John if he was using his journal, since he had not passed along any entries to me. At this point, John indicated that he used his own journal for recording ideas that he picked up at the meetings. Rather than writing his thoughts down, he felt he was verbally discussing his reflections at the meetings. Again, the issue of structure and my role of facilitator arose, and again I chose not to make demands in lieu of maintaining a more collaborative feel to the project.

Shirley's accomplishments.

Shirley continued to implement several activities and organizational strategies that were related to her original desires to 1) develop reflection questions, 2) continue to use manipulatives and real-life examples and problems, and 3) improve discussion (linking concrete

activities to book exercises). Sometimes she wrote in her journal about her decision to act on these ideas and sometimes she wrote her reflections on what happened. In our meetings she shared that:

- after doing lots of hands on activities and reflection questions, students did poorly on a skill oriented, measurement unit test. Shirley decided she needs to have "bridging" questions on her tests.
- students "reflect" on their unit test by categorizing their errors.
- all algebra expressions and equations are to be tied to concrete examples. Shirley felt students reacted positively to this.
- introducing a marking scheme for reflection questions, allowing students to rewrite parts of the scheme in their own words and then using the scheme to assign marks to student reflection answers (which Shirley got from my classes).

Shirley mostly talked about the development of these activities and discussed her feelings about them. In particular, she felt students were feeling more positive and less uncomfortable about algebra. She did not believe she had data to back up her impression, and felt she needed an observer to come into her classroom.

On November 14, I was able to visit Shirley's class in order to observe her teaching. Shirley and I had agreed that this first visit was mainly to allow Shirley and the students to get used to me being in the classroom. I was to make observations on her bridging discussions at subsequent meetings. In my view, the class went very well. I was anxious to have a debriefing after the visit because I sensed Shirley was nervous about the class. She postponed the debriefing for two days, and

finally reluctantly let me talk about it with her. After I told her that I liked the class and the idea that she used (which I later used in my class) she relaxed and talked more freely about the class (this was not recorded). However, she never did invite me back. I asked her about it in January and she said that she thought that it would take too much time for her to feel comfortable about my observing her.

Summary and reflection.

During this time, I was still very focused on the mechanics of implementing activities and reflection questions and I was not sure if my "data" was conclusive about my focus problems. For example did the reflection questions "promote mathematical connections, use of mathematical terminology or reflection on learning" (appendix 5)? How would I collect and analyze data that would answer these questions? John also did not have data that addressed whether students were "keeping track of [their] understanding of math" or if students felt "encouraged to reflect and take responsibility for their math learning" (appendix 6). This issue of data collection and analysis was one that I unconsciously avoided. I was not sure what I could do about it. Perhaps my lack of experience created a fear that I would be unable to lead us to a solution. When the issue of data collection became unavoidable (November 30), my fears were realized.

Shirley did recognize that she needed data that would help determine whether students were feeling more positive and less

uncomfortable about algebra. She decided to collect data by letting me act as an outside observer. Unfortunately, Shirley's lack of confidence with the new activities made her very anxious. Her discomfort was an impediment to the action research plan that she had in place. She was not ready for this kind of data collection.

I purposely chose to avoid giving direction to the project for these six weeks. John seemed content to continue his plan as it was and Shirley still did not formalize a plan. My decision to let John use the meetings as his only source of reflection was troubling because that was not how my research project was originally designed. I was feeling it was time to provide more structure.

Guide-post 6: An Attempt to Improve Collaboration

By November 30, I realized that John and Shirley had made no attempt, on their part to write up their plans, reflections or revisions. I had hoped that they would take a more active role. I decided that perhaps they needed more responsibility in order to feel more ownership over the project. It is for this reason that I asked John and Shirley if they would like to run some of the meetings. Here is what happened when I proposed this.

Nancy: I have concerns about the project - in terms of, first of all the collaboration. In that, I don't want it, it is my project but, I have been running each meeting in the sense of kind of leading whatever goes on. And I was wondering if you guys would each like to do a meeting. Like maybe the next meeting, Shirley do it and make her own agenda of what's going to get covered. And then the next meeting John does...Do you want to do that?...I guess the advantage of me doing it is you don't need to take the

time to plan. You know, I've got quite a background on what action research is. What we should be doing here. I just don't want to be doing things that you know you would rather be working on something else.

John: How will this help your project?

Nancy: It makes no difference. I mean, the collaboration is mainly that you guys feel that you have full say in what's going on. That you don't feel that you have to do things because I say that we have to do things....

John: I've felt that I could bring up concerns that I've had. I haven't had too many. It's going along quite nicely, I thought. So, I'm happy the way it's going.

Shirley: Yeah, what I enjoy about these meetings mostly is that you know if I have had concerns or questions. You know that they are being addressed.

Nancy: That you should bring them out at a meeting.

Shirley: Yes. That I was trying this and that didn't work and how did other people feel. This theirs work or what made it work. That kind of informal discussion, so far, has really addressed most of my pressing concerns.

Shirley and John liked the organization of the meetings and perhaps saw my suggestion as an extra burden. This may be due to their already demanding schedules and in part to their view that this was *my* project. It was becoming apparent to me that John and Shirley would only hand in journal entries, make action plans and lead meetings if I *demand*ed it. I was very uncomfortable "telling" John and Shirley what to do. One of my concerns before starting this project was that the three of us maintain some sense of equal power. Thus, it was puzzling to me that

components of action research touted in the literature did not occur naturally for all participants.

Guide-post 7: Revival of Formalizing Our Plans

In response to my perceived need for written action plans, I decided to “guide” this meeting so that all three of us write up new action plans (or revise our old ones). I had been reviewing the Carson et al. Action Research Handbook and I was recently inspired by a process of identifying perceived goals of the project, introduced to me in a course on Curriculum Implementation by Walt Werner. I began to explain to John and Shirley what we were going to do and why.

Nancy: The first few meetings I really tried to keep it focused and gave you guys the sheet to fill out and stuff like that. And then, for a few meetings, I just wanted to let it go. I just took pressure off of everything and I just let things come out. Let things flow. And I felt better actually about that. Like I felt discussions just were really good. But now I’m starting to look back and I’m thinking, what I really want to do today is just talk about particularly the action research model. Just take a look at what we are doing and do we want to change anything? Or do we want to define things a little bit better?... I felt the three of us could sit there, and without talking to each other, just write down what we feel our perceived goals are in this project. Just not what we said they would be. Just what you are perceiving as the the goals. And then the second thing, what are your concerns. It could be in any sense. Like, do you have a concern about the goals that we made? Like they’re not being met or that they’re not the kind of goals that you like or do you have concerns about planning. Do you have time to plan. Is planning working?...So, we’re looking just right now at what to us, what is your goal for being here in this project? And we can talk about that. Can we do that now?

Shirley: Uh huh.

John: Is that different than what you gave us last week as far as what we said would be our goals? [the previous week I had reviewed for John and Shirley what they had chosen September 8 to be their focus problem]

Nancy: Oh yes, last week I was telling you , I was bringing up again what I thought was mainly our concerns. We said we wanted to see these changes taking place.

John: Yes

Nancy: It might be the same. OK.

John: Those were similar to goals?

Nancy: Yes, it could be that that is what you see as what you're going to accomplish in this project. O.K. You had those concerns in the summer. You want to still address those concerns now?...Or do you still want those to be the goals of this project?

John: Yeah, O.K.

Nancy: So it might be exactly what you said or it might be slightly different than that.

What I thought would be a simple process of re-evaluating our goals was in fact very confusing. One problem was the confusion between words like "goal", "focus", "problem" and "concern". In previous plans, I had used the word "problem" and now I was calling it a "goal". In our conversations we often referred to the problem as our "main concern" while in the conversation above the word "concern" also referred to possible difficulties in achieving our goals. This confusion is again evident when I asked each person to make a new plan,

Nancy: O.K., lets just look at, I think, four parts of it. There is the planning part, there is two parts in that, one of the planning parts is what is your problem. We made plans but I don't really feel like we actually wrote them. I would like a single sentence of what is

the problem.My problem in general is, I think, to me, would be "can I change my beliefs and my concept as a teacher so that I am able to teach more of the Standards"....The problem then, has to be general enough that it addresses what your concerns are but not so general that you are going to be spread all over the place too. Right? The plan is what really starts focusing. So maybe you have a problem with a whole bunch of concerns, but pick only one concern, make a plan of what you want to focus on for the next two weeks or what ever. Then, in your plan, you have to decide how you are going to observe data or what ever, so that you are addressing the problem.

In reality, I was trying to give a mini course on a subject in which I have only theoretical background. I feel I lacked the experience and understanding needed to be able to answer John and Shirley's questions. However, I continued to try to get John and Shirley to make a plan, despite the confusion.

Nancy: Let's just write this down on the bottom of your sheet ...this sheet is close to what I am talking about, but I think we need to add a couple of things in there. First of all the plan. Identify a problem, and lets try to do one sentence. The problem can be in the form of a question or something like that. And a plan that is going to be specific for the next two weeks. Because in two weeks time when we meet again, or even two weeks later, so it might be four weeks, you might then reflect back and say, O.K., I see things very differently now. This isn't my problem anymore. My problem is now going to be this. And I am going to alter my plan. Or, this plan isn't achieving my problem. I need a different plan. That way we are reflecting or revising what we are doing....And it's not really a bad thing for your plan to, for your problem even, to be changing.

John: But it is important to write the problem down, now, even though it evolves into something in two or four weeks.

Nancy: Yeah, and then we have this documentation of what our problem is. What we tried, looked at, reflected on, and then you

can really see the evolution. The things you tried and reflect back. So it's important. And maybe that is how the journal will start looking like.

Shirley: The problem should be longer than two weeks.

Nancy: The problem is a big concern you have. Your plan can be several weeks. You could say over the next few weeks I am going to try to do this. Your plan might change next week.

Shirley: So you want a problem, and then a plan -

Nancy: -to address the problem. And then, a plan on how to collect the data. How will the data be collected. That's part of the plan.

Again, I felt my inexperience in formulating an action research problem and plan prevented me from clarifying what I wanted John and Shirley to do. However, we discussed how we might make a problem statement and we agreed that all of us were concerned about communication and understanding.

Data collection and analysis.

Then, Shirley brought up the question of how we would assess this. At last the issue of data collection and analysis was unavoidable. I realized that she was concerned about assessing whether or not students were communicating and if they were demonstrating understanding. In my most recent readings, I remembered several articles stressing that we should research our *own* practice. I tried to explain this to Shirley,

Nancy: You want to improve communication and understanding. Assessment is just part of the plans. It is one of the things you have to think about. It is one of the concerns. And another thing

that I am seeing here, or thinking, is that we want to look at our practice, in terms of the kids communicating better and understanding better. Not the actual kids themselves, even though that is indirectly there. But it is our practice we have to change. Not the kids.

Shirley: But do we measure - How do we measure?

Nancy: By the responses we have gotten from the kids. So, yes, we need to look at what the kids have done and what interactions you have had with them and part of your data can be what they have written and things like that.

Shirley: But their achievement or not their achievement? The marks on the tests?

Nancy: But what you did. For example, in the reflection questions I have been giving, I have just been collecting them in, looking at what they have done, and so on and so forth. And what I see now, in reflecting back, one of the things about doing them, is that I was not following up on them. I would write stuff on them, but I would give it back to them and I don't think they took any of that stuff in. They just stick it in their binder, or lose, or throw it away, and that would be the end of it. And maybe 5 kids would benefit. But I don't think the rest are. And maybe what I need to do now, I am only giving them once a week so the other day, we spent 15 minutes talking about what was handed in to me and then possibly rewriting it. So my practice, I felt, wasn't perfect, in the sense that I wasn't following up on things. So, I need to reflect on my practice and change it. And I am going to try something different now. It is my practice that has actually changed. The kids are going to change because of that. So it is very much a focus on...what did I do in the classroom.

John: Well, if you plan to change your practice, you will see a difference when you assess the children.

Nancy: Yes, my data is coming from the kids, there is no question about it. It is just that my plan is my practice. I can't plan what the kids are going to do. All I can do is do something to my teaching that will hopefully get good results.

John: So we have a problem statement that says we are concerned with the communication and understanding that the kids have, and our problem is to improve that.

Nancy: We are actually improving our teaching so that they can improve that.

I was finally starting to realize that our action research problems should focus on our own practice but it was still difficult to separate collecting data on our own practice and collecting data on the students. For example, if I want to change my practice so that students are communicating better, I have to see that communication activities are happening in my classroom and that I am comfortable with them. But I also want to know if these activities are effective, that is, are students actually communicating better, or, does increased mathematical communication improve understanding? For me, change in my practice (either technical aspects or my feelings about the change) seemed easier to assess and revise, but *effectiveness* of that change seemed to require a more in-depth, rigorous, sociological research, which I didn't have time or training for. Yet, when Shirley was concerned about "assessing" students' communication and understanding, it was the latter issue of effectiveness with which she was grappling. At this time, however, we were only vaguely aware of a potential assessment problem. This is evident in our new plans that were developed after this discussion.

Nancy's goals

On November 30 I had written that my perceived goals were,

To implement aspects of the Standards in my classroom. To be

able to change my role as a teacher, concept as a teacher and change my teaching style so that I am teaching more in line with the Standards.

By December 5, the focus problem for my new plan was more specific (see appendix 5 for the complete plan). It read,

I want to increase students' relational understanding of concepts and procedures and provide opportunities to demonstrate that understanding through written communication.

Without realizing it, I had once again created a goal (or problem) that focused on student learning. However, many of my observation questions were aimed at reflecting on my practice. In fact, I felt better about this plan because I was more confident that I could collect relevant and useful data. I hoped to answer the following questions.

- 1) Do more students hand in the reflection questions?
- 2) Is the quality of work on the RQ's [reflection questions] better than before?
- 3) Do I have time to evaluate the questions?
- 4) Am I able to follow up on RQ's [reflection questions] after they are marked?
- 5) Do students use good communication in the reflection questions and during the sharing period?
- 6) Do students demonstrate good understanding through RQ's [reflection questions]?

I was successful with collecting and analyzing data on questions 1, 3 and 4 because these had to do with the technical aspects of implementing the reflection questions. For example, regarding the rate of return I said,

Four of them didn't do the last one that I just did. And that was the review one. And then there was a lot of people away too. And oh, only three people didn't do the one before that. Except I got a lot of ones and two's out of five. And I give them a chance to redo it and they didn't do it. I have talked about it so maybe they got

the point. I will find out when I do the unit test.

I was having a great deal of difficulty figuring out if quality had improved. For me, the question of quality required a much more in-depth look into the many variables that affected quality. For instance, one of my concerns was that perhaps the reflection questions I assigned were more difficult each time,

Nancy: Every one of these reflection question's, there is something that they need to be careful of and they are not. And this is what is frustrating me. They never know what this thing is that I am looking for....Now what I realized... that I could do differently with this question is to say, not to booby trap, but say, "in the questions on page 146, you can multiply both sides by the lowest common denominator to get rid of fractions. Why can't you do that in the questions on page 122?" So that way I am saying right up front that you can't [get rid of fractions in the page 122 questions].

While it was difficult to make any conclusions about "quality" of responses, it was quite important to reflect on the nature of the questions. I did not do a rigorous analysis of my students' responses but I made revisions in my questions based on my intuitive reflections.

I was also unable to draw conclusions with respect to questions 5 and 6 (student communication and understanding), and these questions too, focused on effectiveness of the reflection questions I had incorporated into my classes. But again, reflection on these matters were valuable to my understanding of the use of reflection questions.

For instance, as I reflected on the experiences with a particular student, points about the value of these activities became apparent.

Nancy: One of my students, this is a fairly bright student, but quite

often doesn't do his homework. He does well on tests and he is now starting to be concerned with his mark. He said "What is more important. What is worth more marks, the homework assignment or the reflection questions?" And I said the reflection questions is worth more marks but the assignment, in the long term, is going to be worth more marks because you will do better on the unit test. Then I started thinking, "wait a minute, what am I saying here!" Am I making them spend more time on this, because I really need them to do it all. Because, it is almost like there is two different things and I think they should be balanced equally. But ...are these three reflection questions worth the same amount of knowledge as all of these questions that I have assigned in the book?...I think what [the student] is trying to do, and I am not sure about this, I think he is trying to get out of homework. He is willing to do work in class for the one hour and twenty minutes, but what ever he doesn't get done in class he is not going to take it home. So he is trying to figure out what can he cut out.

This reflection, then, made me think about what message I wanted to send to the students about the importance of these reflection questions compared to other book work. I drew no conclusions about effectiveness per se but I was dealing with related issues.

I had also given my students a survey to determine their disposition towards the reflection questions. I found the results disconcerting. Generally, students expressed that the reflection questions were not beneficial. But, then, I reasoned, many of the students did not like doing the reflection questions and were therefore very critical of them. I could sense that they felt that if they complained enough about them, I would not give them any more. In fact, I did feel like quitting right then and there. Encouragement from John and Shirley helped me over come this. Instead of giving up, I began to ponder a new

focus for my classroom research. I now wanted to ask the question, "how could I get students to feel more comfortable with the reflection questions?" or "how could I get students to see the value of reflection questions?"

Unfortunately , I did not follow up on these questions because by this time my student teacher had taken over most of my classes, our project was coming to an end, and I shifted my time and energy commitments toward analyzing the project's data.

Shirley's goals.

On November 30, Shirley identified her goals to be:

To improve my practice of teaching grade 8 math. To become familiar with the standards and use them as a guide to develop specific units. My main areas of concern are communication - both written and verbal. And a greater in-depth understanding of the material and evaluation afterwards.

This was the first time Shirley acknowledged that becoming familiar with the Standards was an important goal for her action research. This acknowledgement was not evident in December when Shirley produced her first detailed written plan (appendix 8). She used the original format which starts with the action to be taken (activity) and follows with focus problems that it will address. Her focus problems were as follows:

- (1) Address unclear thinking. Promote logical thinking.
- (2) Address misuse or non use of math vocabulary. Promote effective mathematical communication.

At the January 9 meeting, Shirley had only just begun to execute her plan. She was learning a great deal from the activities that she gave to her students. After letting the students rewrite a criteria analysis sheet for the reflection questions, she had her students discuss how they would mark examples of reflection question answers. At the next meeting she said,

It was very clear to me when students didn't understand because I took two very good questions and two that I wouldn't give good marks, and some of the kids couldn't tell the difference. It was one of these things that was very enlightening. And of course if they can't see the difference, then no wonder they can't answer it....they don't even know the difference [between a good answer and a bad one]. So, that isn't just important in math, it is important in everything. And it is one of these skills that I would like to emphasize in math and science 8. So that was really interesting....So that was one thing that I got around to doing and I was pleased.

And later, Shirley described how she set up the reflection question assignments.- She then said,

I think I preferred it that way. At least until I have become more comfortable with it. I don't want it to be something big and obvious....especially when I am not really sure of it. They are going to be examining something that is real different. And I don't want that critical mass of minds trying to focus on this when it is not fully clarified.

Shirley was very concerned about implementing aspects of the Standards in her classroom, without creating student backlash to change. This meant she needed to be comfortable with what she was doing, and she had to structure her activities so that the students would not notice any

great change. This meant she had to go slowly, yet she sometimes felt disappointed that change was going too slowly.

In terms of Shirley's November 30 goals, she had made improvements in her practice. At the January 23 meeting, when asked what the collaborative group did for her, Shirley replied,

It's not really the skills that I am getting here, but it is the flavour. Which is what I don't have. I have the flavour of science, but I don't have the flavour of math. And talking about it and discussing it has given me a lot more of the flavour of what math is....[working with the group] has done a lot. It has helped validate my, what I think is okay, but I didn't know was okay. And coming here and discussing things was really- encouraged me to carry on and not just mindlessly put out the worksheets. Because it is a lot easier. It has made me a lot more confident as a math teacher. And a lot more confident in what I am doing and what I believe is right.

The discussions were important to Shirley. We could validate her ideas, encourage her to continue, and support her in times of conflict.

John's goals.

On November 30, John's perceived goals for this project were,

- (1) to be able to see students communicate math better
- (2) to be able to see an increase in student achievement
- (3) to share ideas about effective math teaching with other teachers
- (4) and to ultimately become a more effective teacher

Notice (1) and (2) focuses on the students while (3) and (4) focus on John's practice (although John did not explain what he meant by being a more "effective" teacher).

At the January 9 meeting John told us he had not assigned journal

questions lately because he didn't want to mark them, yet he did not share a revised plan with us. By the January 23 meeting, he had done another set of student journal entries and shared with us written comments that he made in his own journal,

John: I have found student journals enlightening in that they have caused me to do much reflection on my own teaching practice. It took a long time to mark because my mind would wander to those practices that I am not too proud of and what I would do about this. So, it took longer to mark than anything else, because as I was marking them, I was thinking about what I was doing in the class. And then, I would suddenly realize that in five minutes I am still looking at the same person's thing. Because that person would, I would be reminded of something that happened with that student when we were doing this material or something where I could have presented a different way. Or I did a good job because it was down there really quite plain, and the students articulated it well. So it really-

Nancy: Maybe a thing to keep an eye on now is noting if you consciously redirect how you do something because you remember an experience that you had that is-

Shirley: Did that result in changes?

John: Well (big pause)

Shirley: It has inspired thought.

John: Any time you reflect on what you are doing, good or bad, I think it causes changes.

Nancy: Even subconsciously.

John: Oh, there are changes that you don't even know about. But as far as actual big changes, or changes that were really noticeable, it is hard to say.

I was making one more attempt to encourage John to pursue another focus for action research. John was disturbed by his recollections of certain lessons and this reflection might have proved to be an excellent source for reconnaissance. The conversation drifted away from the topic of his reflection and we did not discuss it again.

At the February 28 meeting John said,

On the one hand, when you do journals, there is an increased marking load, noticeably increased. Because, journals take effort and energy to mark. They take effort and energy for kids to do, and they take a lot of energy to mark. So, I started a new term, this is the second week... and I haven't done the journal and I am enjoying the break. so, I am wondering , why don't I just keep enjoying the break right until the end of the semester.

Shirley and I gave suggestions on how to cut down on other marking (quizzes) but John had his reasons for doing things the way he did. So Shirley pointed out that it comes down to deciding what is most important, journals or quizzes? John reflected,

What did they do for kids last semester when I did journals? Were they worth, for the kids, the effort that I put into marking them. Because I know, when I mark quizzes, when I give them back to them, the quizzes are on a very narrow part of the math, so they tend to do really well on them. And I know that most of the kids are really feeling good about math, right now. So, I am starting to wonder, are the journals really doing a lot for the students? I can mark three quizzes in the time it takes to mark one set of journals....by spending a lot of time marking these [journals] , did that take away from that energy that I spent being a teacher. That total energy. And I don't know. Maybe it did. Maybe I can go in there and be a more effective teacher because I am not as tired. Because I am not marking journals.

Despite all of the wonderful responses that John's students had written

and despite John's earlier insistence that the journals were so important, he came to the realization, at the last meeting of the project, that he would not like to continue doing journals. This conviction, again, carried over his view of the Standards in general. Shirley and I were concerned about this and tried to encourage him on:

John: I would like to have done more of the Standards, but I don't want to penalize my students.

Shirley: How about at the grade 8 level?

John: Oh, I feel a lot of freedom at the grade 8 level. Because it is more than 50% review of the grade 7 stuff. So I do all kinds of things in grade 8 that are projects, like cut and paste, projects and computer work. But as soon as you get to grade 9, and academic math, and then grade 10 and grade 11 and grade 12.

Nancy: Maybe you are thinking in terms of your journals. Right now. Is it, to you are the journals representing the Standards? Because there is a lot of other little aspects.

John: To tell you the honest truth, I have not analyzed the Standards documents enough to make a valid comment. My comments come from just what I understand. Which is a very small part of the Standards.

Nancy: So, how about if we continue to have these meetings. How about it you were to move on to something different?

John: Ok, if we were to do that, I would like somebody like yourself who is very familiar with the Standards documents, I would like to come to these meetings and for you to tell me more about the Standards. Because I don't want to read it. I don't! I have other books that I am reading that I think, right now, are doing more for my math classes than the standards are. One by Anthony Robbins. Awaken the Giant Within.

Shirley: Is this particularly math?

John: No, this is success. It is basically success. So, anyway, I would like a lot of more information about the Standards.

Shirley: I found some of the examples in the Standards really wonderful. I don't know my math well enough to necessarily implement them to the fullest. But it would be really useful to pick out some areas in the standards for us to discuss and to discuss the examples that they have. And I think that would really broaden, I would really appreciate that to have more math input.

Nancy: A talk that I just went to, they just pulled out a whole bunch of things (from the Standards) and put it into about six pages. So they had like 18 questions or activities, and they had us go through and discuss how would we extend this activity.

John: I would love to do that, that would be great.

I was taken aback that John had not, in fact, read the Standards. That was, after all, the agreement upon entering this project. He was even given two release days. Up to this point, I had assumed that he was familiar with the Standards, comfortable with them and was now trying to implement one aspect of them, just as I was.

Three stages of readiness

Later, while analyzing the transcriptions of this project I became aware that John was probably at a different stage than Shirley and I. As he stated at our last meeting, John wanted exposure to standards oriented activities. That he only used his journal to write down ideas from Shirley and I, provided further evidence of this. It is possible that had John's needs been met, he would not have come so dangerously close to going back to traditional teaching.

On the other hand, it seemed that Shirley was at a stage where she needed to focus on feeling comfortable with the Standards. This meant dabbling in the Standards oriented activities, but not fully implementing any one activity in particular. It is possible that if her action research problem had focused on becoming comfortable with the Standards, her reflections would have been recognized as valuable data. Her concerns that she was not focused would have been alleviated.

And I was at a another stage. I was familiar with the Standards, somewhat comfortable with Standards philosophy in my classroom and ready to fully implement one activity. I had difficulty in refining my focus problem but I felt successful with my cycles and believed they implement reflection questions in my classroom.

Understanding what happened.

Many times discussion would help us come to a better understanding about what really happened in our classroom. Another example of this happened at the November 30 meeting, prior to the goal setting activity. John expressed frustration with the Standards when his students did not perform well on a test on percents. He exclaimed,

Well, I have a concern about the standards and the mathematics curriculums and all this other stuff, what we are doing here? Whether it really helps students. I have lingering doubts. I'm a bit of a skeptic, but I've always been a skeptic.... if you take for example a concept like percent and you do things with the students like "real life" type computers and spreadsheets and doing percents. Does it really help them understand what percents are? Because I've done that and given them a quiz and been disappointed with what was on the quiz.

John's disappointment in his students' results on the percents unit test led him to become skeptical about the Standards. Shirley and I questioned John in search for the source of his difficulties. We suspected a mismatch between what was taught and what the focus of the test was. Here is an excerpt from our conversation.

Nancy: What kinds of things did you test them on?

John: Oh, it was just really basic percents. Changing percent to a decimal. You know. Understanding that a percent is a decimal. And also that it is a ratio. Pretty basic understanding.

Nancy: So you're comfortable that whatever assessment there was reflected exactly..

John: Well, I am not comfortable with that either.

John began to realize that his student assessment needed to better reflect the activities that he used which focused on *uses* of percents. After the project ended, while analyzing the data for this thesis, I once again asked John about this percents unit. I was suspicious of his use of the words "pretty basic understanding". In fact, John had done the spreadsheets activity several times at his old school and everything went well. This time, he was at a new school, where the computers were set up differently. He had to spend a lot of class time just figuring out how to use the computers. Meanwhile the lesson lost clarity and strength. Students were dealing with the confusion of setting up the computer program as well as the new material they were learning. By the time they

finished this activity, John felt they had wasted a lot of time, so he did not spend much time teaching the "basic" computations. He had assumed they would know these already. Upon testing them, he realised they didn't know their computing skills.

So, in fact, the apparent problem was that the spreadsheet activity had not worked as planned because of changed conditions. John realized that by tightening up the computer lesson, he could provide a better lesson on uses of percents and would also have more time to spend on computation. It was through the aid of discussion that John was able to fully understand what had happened in his classroom.

Support

I was concerned that John did not benefit from the project. However, when asked, at the January 23 meeting, how the collaborative group helped him, he felt it was very supportive in resisting a strictly traditional approach to teaching.

John: Well, obviously, the things that you were doing and what you are doing Shirley, those things I have kind of written down and really thought about, and doing some of them. So, the meetings is [sic] helping me with the "hows" as well. Not very many people in our district are doing what you are doing Shirley... there are too many traditional teachers. I feel a wave of traditional math teaching coming at me. Almost all the time.

Nancy: This is like a counter tide.

John: It boosts me up. It helps me to continue to do the things that I think math is all about. It would be more difficult for me to be a "different" kind of teacher. I feel myself going toward that traditional thing. When I have piles of journals to mark. I just feel like quitting and giving them back and do the the other thing. I

want a life here now. But it has helped....It has been a really beneficial thing for me. I like to get ideas on how to teach math. I like that.

Shirley and I also expressed frustration with external pressures from the ministry of education (curriculum), district administrators (assessments), department heads, students and parents. Most times there was little we could do about the immediate situation. But discussion provided validation of that frustration and support for continuing on.

Epilogue

As I was writing this thesis, I continued to struggle with the difficulties we had in documenting our action research plans; specifically, stating our research problems. The more I reflected on the transcriptions the more I realized that what we wrote as focus problems was not what we actually focused on. Our plans would state our focus to be on what students achieved yet, in our discussions and reflections we would describe what we achieved (how we felt, what we did, what was reasonable for our work load). If Shirley had written "How can I become comfortable teaching mathematics with Standards activities?" and John had focused on "What activities am I comfortable doing that provide alternatives to drill exercises" and I had written "How can I get students to improve and feel positive about mathematical communication?", we would have possibly felt more successful in our action research. At the

very least, our data would have coincided with our personal reflections. So, why then, did we focus on student outcomes and not our practice. Is it because, as scientists (we all have B.Sc. degrees), we tended to choose problems that could be objectively tested? Was it because we were more concerned with whether the activities would achieve greater communication and deeper understanding than we were concerned about how it would be possible to do the activity?

I would classify myself as an experiential learner. I had read the literature on action research but it was not until I had carried out the project action research cycle that I began to understand or internalize what I had read. When I re-read literature on how to do action research, every source clearly stated that the problems should be focused on the researcher's practice. For example, on page 1 of the Carson et al. Action Research Handbook, there is a list of sample questions that the teacher researcher may inquire about. Most questions start with "How can I..." or "How might we...."

Throughout the project we do answer the "how can I" questions, but I realize now, why we often did not feel like we were doing action research. Primarily, we did not feel that we were able to answer our "written" focus problem. How to collect data on whether or not the activities improved student performance (effectiveness) proved to be very difficult. Thus, we had interpreted our lack of progress in answering these learning outcome questions as our ineffectiveness as

action researchers.

Chapter 5

Analysis of One Cycle, Preparation For the Next

My focus question for this thesis was "What themes recur when teachers use collaborative action research as a vehicle for implementing aspects of the NCTM Standards?" I have described events in chronological order in order to demonstrate the evolution of five recurring themes:

- 1) Research expertise
- 2) Structure
- 3) Classroom research focus
- 4) Readiness
- 5) Group discussion

Research Expertise

This project was designed so that teachers could work together, developing an understanding of an action research model so that they may create their own action plans for change. It is for this reason that I gave John and Shirley copies of the Carson et al. Action Research Handbook to read over the summer. I expected them to read the handbook and each of us would then contribute our own "expertise in a collective process" (McKernan, 1988, p. 180). Since I had taken a course on this research method and had done an extensive literature review before the project began, I recognized that I may have more to

contribute in this area than the others.

To assume that Shirley and John would have time and motivation to read the Action Research Handbook, as well as the Standards may have been naive. Thus, that they turned to me as expert to teach them the process seems warranted. I now realize that my knowledge and expertise about action research was limited to theoretical background. I had never *experienced* action research before. I did not fully understand the process, and consequently, I was explaining things mechanically. I was trying to give John and Shirley steps without being able to explain the rationale. In fact, some of the "steps" I gave did not parallel suggestions in the literature. Ironically, this is exactly how we did not want to be teaching mathematics; rote memorization without understanding. This lack of experience and understanding in action research obviously affected my ability how I facilitated this project.

Doing this project has given me experience with action research and time to reflect on that experience. However, I feel I would have benefited also from working with others to explore the action research process. With the many layers in this project such exploration was limited.

In this project, full collaboration on gaining knowledge about action research and sharing that knowledge competed with our desires to come to understand the Standards and carry out change in our classrooms. As facilitator, I needed more experience with presenting

and clarifying action research to participants so as to relieve some of the time pressures of the project.

Structure

This research project was designed so that John, Shirley and I would be using collaborative action research as a means for implementing the Standards. Therefore, as facilitator, I was often concerned that we produce and carry out planned research cycles. As the project progressed I was becoming aware that John and Shirley were not taking much initiative to read about or follow an action research process.

For example, I found that John and Shirley would not write up their plans unless I insisted that they do so. Even then, it didn't always happen. John wrote up a plan after my first presentation of the planning sheets, August 30, but did not write up a second plan, even after I had lead the group through the goal setting process, November 30, and said "Anyway, I am happy if we go away and each of us make a plan". Shirley didn't write up a plan after the August 30 meeting but did write her first one up after the November 30 meeting. Neither volunteered documentation of their action research cycles during other times. As researcher and facilitator, I experienced a tension with structure while the other participants seemed pleased with the networking and attempts to change.

This created a struggle for me. Do I demand that plans and journal

entries are made? Or let the participants do what suits them most? If I insisted on structure, would I be imposing my research needs over John and Shirley's individual needs or would I simply be providing guidance? If I am providing guidance, how can I do so without feeling like I am making demands? These are questions on which I continue to reflect.

Classroom Research Focus

Throughout most of the project, we often felt we were not doing action research. For John and Shirley this seemed partly attributable to their lack of documentation of their plans, actions and reflections. But more obvious was the discontent we felt with respect to collecting and analyzing data that addressed our focus problems. The three of us tended to focus on the effectiveness of implementation regarding student outcome. Sometimes we would bring student work to the meetings but we were unable to do sufficient analysis, either individually or as a group, to convince us that there was "more understanding" or "better communication."

Rather, we felt much more inclined to discuss evidence we collected on the mechanics of implementation or our comfort with the new activity. For example, John was working out an appropriate marking scheme for his journals, I was working out when and how to give reflection questions, and Shirley continually discussed her comfort level in using standards oriented activities in her classroom. We were collecting and analyzing data that did not match our written problems

concerning student achievement. We thus felt as if we had failed.

It is now evident that there were two types of evaluations. One type has to do with the effects on our practice when implementing the activity. That may concern us with the mechanics of how to do the activity, or it may concern us with our own reaction to doing the activity. It is not too difficult to collect and analyze data on these problems. I, for example, could easily determine if I was getting a greater return on reflection question responses. Shirley could reflect on her feelings to determine if she was more comfortable doing Standards oriented activities, or she may have determined which activities she prefers to do.

The other type of evaluation has to do with the effectiveness of the activity on student outcome. For example, are the students really communicating better when doing this activity? Or is there greater understanding after using concrete materials? It was difficult for the three of us, as practising teachers, to immerse ourselves in our data while dealing with the daily demands of the classroom. With added pressures of working out the mechanics and feeling comfortable with a new activity, we were unable to do the in-depth analysis we assumed was needed.

However, as I pointed out in Chapter 4, *intuitive* reflections on effectiveness of an activity were valuable. For example, reflecting on whether the quality of the reflection questions had improved, raised

issues about the way in which I had posed the questions. While Shirley was reflecting on her students' understandings, she came to learn a great deal about why they have difficulties writing good answers. She was not able to determine if students had a better understanding, but she was able to learn more about their understanding.

Readiness

Throughout the project, I was acutely aware that Shirley was having difficulty collecting data that related to her focus problems. Also, she was always critical of herself for not doing more of the types of activities that she had in her plan. Meanwhile, John and I thought she was experiencing a great deal of growth.

In January I started to question the value of the action research format for Shirley. However, when I analyzed the data, I realized that had Shirley focused on developing a comfort level with being a Standards oriented mathematics teacher, she would have been able to give credit to the growth that she was experiencing. I had already gone through such a process in my previous five years of teaching math. I still try other Standards oriented activities, but at this point, I was ready to focus on two specific ideas; the reflection questions and concrete activities.

I, therefore, came to the conclusion that Shirley was at a different stage of readiness than I was. She may have benefited from acknowledging a different kind of focus, a focus on becoming *comfortable* with the Standards. Shirley didn't want to fully implement

reflection questions, concrete activities or unique problem solving activities. She simply wanted to see what these look like in the classroom.

At the February 23 meeting, I asked her if she would want to continue the process of dabbling, or would she want to focus on one thing. She said,

I think it would be useful, I think it would be smart if I limited my all-over-the-placeness. If I said to myself, Ok, I am just going to change one unit. I am going to write up my algebra unit, so it was presentable to other people, so I can work on my own communication. Or doing the graph thing. Like, I really think I should have one focus. And write it up. Develop it more thoroughly. Because this year was dabbling. And some things I won't do again. Like I don't think I will do journals for journals. I am really quite clear on that. Where as, perhaps, before I would have done them. But I don't want to do them....I think it would be useful at this stage. Like I have messed around enough.

Shirley's need to dabble and discuss her comfort level indicates that perhaps it is important that teachers at this stage spend a year or two trying things out. For Shirley this was an important part of the process of implementing the Standards.

It was very important for Shirley to be involved in the group process. She said at the February 23 meeting,

The process was reading about it, saying hey, this is a good idea, trying it out, and coming back here, *landing back here* and going HUUUUH, and going this is what happened, this was good, this was awful. How do I change this. So, this was an integral part of the process of implementation. Because the first time through something, it was pretty hard. So, this was really important, the reflection part.

Therefore, the project was very beneficial to Shirley, since it provided support, clarification and guidance and allowed her to reflect on what she was experiencing.

Up until February, I thought that John and I were at the same stage. John had many years of experience and appeared very confident in his knowledge of the Standards. I should have become aware of his lack of familiarity with the Standards when on two occasions he questioned the Standards in general, because two of his activities were not working. He saw the Standards as doing journals and teaching uses of percents. Shirley and I had a more expanded notion of what the Standards were and recognized that some things work for us and some things don't.

When John finally admitted that he did not actually read the Standards, I realized that he was at a yet another stage of readiness. John preferred a setting where he would be exposed to ideas from the Standards, rather than reading the document on his own. The difference between John's stage and Shirley's stage is that John wants to be given specific activities to explore where Shirley already knows about many activities and is now ready to try some in her classroom with the appropriate curriculum content.

Thus, each participant in this project portrayed a different stage of readiness. These stages correspond to Shaw and Jakubowski's (1991) requisites for change. In fact, this project adds to the understanding of these requisites in the context of implementing the Standards.

Requisite three, constructing a vision of what the classroom could be, seems to correspond to "stage one" where the teacher explores examples and ideas. Shirley and I had done this on our own. We attended Standards oriented workshops at mathematics teaching conferences and we read much of the Standards documents. For many teachers, however, it may be necessary to bring the Standards to them.

Requisite four, projecting oneself into that vision seems to correspond to "stage two", where the teacher "dabbles" in Standards oriented activities. This project showed that a comfort level with a vision is an important component of this stage. Shaw and Jakubowski (1991) never mention comfort level. In fact, when a teacher tells them she has lost confidence because she has been unsuccessful in implementing a teaching strategy, Shaw and Jakubowski remark that "she lacked a vision of alternative teaching and learning approaches" (p. 17). I would argue that the teacher was knowledgeable about alternative teaching and learning approaches, but she lacked comfort with that vision. She would have benefited from support and encouragement from other teachers in similar circumstances.

Shaw and Jakubowski's requisite five, deciding to make a change within a given context, corresponds to "stage three" where the teacher may focus on implementing a particular aspect. I underestimated the necessity of working through the other two stages before beginning this stage. I was trying to have Shirley and John focus on one aspect of the

Standards before they even knew what choices they had or with which choices they were most comfortable.

It seems important to note that any teacher may be at different stages, depending on what aspects of the Standards he or she is implementing. While I was ready to use action research to implement a mathematical communication activity, I continued to "dabble" in other activities in order to become comfortable in other areas of the Standards. In terms of the standard "technology", I feel I need to attend workshops so that I may be exposed to a variety of ideas before trying them in the classroom.

Group Discussions

Despite our difficulties with the action research process, Shirley, John and I felt we benefited greatly from being involved in discussions every two weeks.

The Standards consist of two large volumes and several addenda. Interpretation of this literature in the context of our classrooms proved to be complex. Discussions provided opportunities to clarify our understanding of the Standards activities and the Standards philosophy. At our August meeting we discussed the notions of communication, making connections and developing deeper understanding. Throughout the project we asked ourselves if the Standards philosophy is beneficial to our students, particularly under the present curricular constraints. We never came to any solid conclusions, but we felt our understanding

of the Standards deepened.

Several times John, Shirley or I experienced difficulties with the activities we were implementing. Our initial reaction would be to blame the activity and twice John went so far as to blame the Standards in general. Fortunately, there was always one or two of us caught in the "wave" of the Standards philosophy who would force examination of the problem. Usually, it was not the activity that was the problem, but the way in which the activity was presented or implemented. Most of the time, by the end of the meeting, we would be ready to revise our implementation plan and go back and try it again. In John's case, with the percents unit, it took several months for him to realize the errors in implementation. He is now ready to go back to that unit next year and try it again.

During the discussions we also supported each other when there was no foreseeable solution at hand. While implementing our activities, we were up against many barriers that were deeply embedded in the school structure. For example we would often talk about the imposed district assessments, or pressures from other members of our schools, or students' resistance towards writing in the mathematics classroom. When we shared these frustrations with the group, we were not looking for solutions, we simply wanted acknowledgement of what we were experiencing. Once our frustrations were validated, we would just carry on. I believe if we had not been able to experience this kind of support,

we would not have had the enthusiasm for “going against the tide of traditional math teaching” (John, January 23).

Implications

I have explored the themes that recurred when these three teachers used collaborative action research as a vehicle for implementing aspects of the NCTM Standards. However, these themes have implications for stake holders in education at all levels.

As a facilitator, I experienced many difficulties in this collaborative action research project. Some of the difficulties can be attributed to the fact that despite taking a graduate level university course on action research theory, I had never before experienced and reflected upon the action research process. This created confusion and lead to some misunderstanding of the action research model.

Collaborative action research is an emerging research method and courses on action research are still in the developing stage. In order to better prepare facilitators of action research projects, I propose that action research courses include an “experience” as well as a “theory” component. After all, the purpose of action research is to close the gap between theory and practice (Ebbutt, 1985). The question then arises, “What might a practical component in action research courses look like?” For example should students have their own individual action research project and discuss their experiences in class? Or should the class as a whole be involved in the same process?

Other difficulties or "tensions" would have arisen despite my expertise in action research. In particular, the tension between imposing the action research format on participants and allowing the participants to take their own initiative towards their research. I was concerned about creating a sense of inequity within the group so I was reluctant to make demands. However, it is possible that with a clear structure for action research and time to reflect on teachers understandings of the process, teachers may take a more rigorous approach to their action research and may play a more active roll in collaboration. The teacher's role and the facilitator's role can change as a project progresses and as the teachers feel more comfortable taking ownership over their own research. It is necessary for collaborative groups to have time to learn about the collaborative process and feel comfortable with new roles.

During this project there was a great deal of difficulty collecting and analyzing data that matched our focus problems. Indeed, the problem formation was compounded by the fact that there were at least two types of focus problems and thus two types of data analysis; that which concerns the teacher's practice, and that which concerns student outcome. Both are equally important, but the latter can prove to be difficult for the teacher researcher. Teachers doing action research should consider focusing on the mechanics and comfort level of implementing an activity. While teaching, they may find an intuitive reflection on the effectiveness of the activity extremely useful, but a

more in depth analysis may be better achieved when the teacher is away from the classroom and has time to immerse his or herself in the data.

Another alternative, is for the teacher to focus on the mechanics of implementation of an activity, while an outside researcher does a more in depth analysis of effectiveness. The mathematics education community should help teachers link up with researchers. NCTM has created a research project called Recognizing and Recording Reform in Mathematics Education, where a group of researchers and practitioners are documenting the process of change in mathematics education (Lindquist, 1994). I feel it is important that this project include effectiveness of the change on student learning as well as the logistics of implementation.

Much of the frustration and inadequacy felt by the participants as they used action research may be attributed to each participant's stage of readiness. It is important for teachers to identify at which stage of readiness they are so that they may take appropriate action. Teachers at stage one would benefit from exposure to the different forms that the Standards can take so that they may begin to see what the Standards vision looks like. In my experience, attending workshops on Standards activities usually does not occur at an appropriate time for classroom implementation. Therefore, instead of an action research format, it is possible stage one teachers would find a workshop format more useful. Teachers at stage two may appreciate an action research process for

helping them become familiar with and comfortable with various Standards oriented activities. Teachers at stage three have been "dabbling" in Standards activities and are now ready to use action research to help them focus on one or two particular activities. Stage two and stage three teachers may benefit from working together in a collaborative setting. Teachers at stage two would have the guidance and support from more experienced teachers and teachers at stage three are exposed to more ideas that help them continue the "dabbling" process. District administrators could offer the opportunities for workshops and collaborative projects as well as provide initiatives for getting involved in such projects.

This study sheds further insight into an understanding of the Shaw and Jakubowski (1991) requisites for change. For example, at the outset, I interpreted requisites three and four as something that could be done in a few weeks. I now understand that they can take several years and may require certain conditions for success. In particular, I found it important to address the need for becoming comfortable with the vision of change. More research could be done on this particular component of teacher change.

We often felt that the group meetings allowed us to support each other and encourage continuation of the struggle against the "tide of traditional teaching". This has two implications. First, it is imperative that teachers be given opportunities to work together, in a supportive

environment. Discussions from group meetings proved to be valuable in that they helped us develop a better understanding of the Standards and clarified or validated interpretation of what happened in the classroom. This supports the findings of Taylor and Werner (1989), Leinwand (1992), Richardson (1990) and Romberg (1993).

Secondly, teachers have little motivation to make a commitment to change under such pressures. This was evident when I found that no teachers from my district were interested in participating in this project. Government officials must take action to diminish this tide of traditional teaching. While the Standards have been adopted as official resource material for British Columbian teachers, the curriculum, texts, district assessments and provincial exams do not support the use of the Standards.

My Reflections

I have completed my thesis and I am returning to teaching full time. I intend to continue meeting with Shirley and John as we have all greatly missed the meetings during the writing of this thesis. After spending several months reflecting on my experiences with action research, I feel I can provide better guidance and clearer understanding. At the same time, I think Shirley and John may take a more active role in their research and in the meetings as they too come to better understand the action research process. As well, this will no longer be "my project".

I will continue action research on the student reflection questions

since I already have some ideas for modification. I believe I will be better prepared to reformulate my focus problem as well as my data collection and analysis. I feel that my previous attempts at action research have been clumsy, but that with experience, I am slowly becoming "comfortable" with the process.

I will wait until my comfort level with action research is high before I invite teachers to another action research project. My next step is to lobby my district to provide a series of workshops on the Standards. I can create one such workshop on my own work with student reflection questions. Perhaps after two or three years, I will have developed my action research skills and there will be teachers at stage two or three who would like to partake in a project aimed at implementing the Standards. Again I would lobby my district for support in such a venture.

There are a few changes I know I would make if I were to facilitate another action research project. First I would provide a questionnaire to help teachers identify their stage of readiness. I would explain the stages of readiness to the participants and with the aid of the information from the questionnaire, I would help them identify their own stage. This will help the teachers in formulating their focus problem. This process of stage identification would probably take at least two "pre-project" meetings. Some teachers at stage one may choose to wait until they have attended more workshops or read the Standards before partaking in an

action research project.

I would start with two or three meetings focused entirely on the action research process. I realize now the need to carefully plan a presentation of one or more action research models. Such planning would include careful selection of vocabulary, so as to avoid confusion. I would then follow up by scheduling discussions on action research models. Throughout the project every third or fourth meeting will be devoted to reflection on the action research process. Thus the project will initially have a great deal more structure. Within that structure, teachers will have a great deal of freedom over their own research.

As I gain more experience while working collaboratively with John and Shirley and as I continue my own action research I may make changes or add to the above format. This project was a documentation of a year's journey with action research. It was not the beginning of that journey and it is not the end.

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Appendix 1: Dates of Meetings

June 21, 1994 - at Nancy's home

August 30, 1994 - at John's school

September 8, 1994 - at Shirley's school

September 29, 1994 - at John's school

October 18, 1994 - at Shirley's school

November 3, 1994 - at John's school

November 17, 1994 - at Shirley's school

November 30, 1994 - at John's school

January 9, 1995 - at Shirley's school

January 23, 1995 - at John's school

February 13, 1995 - at John's school

February 23, 1995 - at Shirley's school

Appendix 2: Action Research Planning Sheets

Action Research Planning Sheet 1

Name _____

Time line: _____

Problem or Concern:

Plan:

Data Collection: (journal, student work, video, observations...)

Reflection in journal and at next meeting

Action Research Planning Sheet 2

Name _____

Time line: _____

Plan:

Problems that plan will address:

Cautions about the plan:

Data Collection: (journal, student work, video, observations...)

Reflection in journal and at next meeting

Appendix 3: Initial List of Domains

- A Clarifying beliefs about connections, communication and understanding in the mathematics classroom.
- B Finding a balance between skill drill and teaching for understanding.
- C B.C. Curriculum
- D Assessment
- E Open/Closedness to new ideas or readings
- F Fear of trying new things
- G Beliefs
- H Action research or developing a plan
- J Change isn't easy
- K Collaboration/support
- L Outside pressures/ resistance
- M Workload change
- N Difficulties in implementation
- O How to spend class time
- P Standards in general
- Q Accomplishing growth/ change
- R Gaining mathematical knowledge

Appendix 4: Excerpt from List of Action Research Themes

- H 94 08 30 30. Shirley: Plan - to focus on RQ and discussions after activities.
- H 94 08 30 33. Shirley wants to audio tape or video tape discussions.
- H 94 08 30 Before meeting. Shirley still does not have the response ready for the questions I wanted her to complete for June meeting. She is trying to get through the Standards (we have a meeting later in the day)
- H 94 08 30 1. Nancy gives John responses to his June questions but John never does respond to this. In fact he seems uncomfortable getting this feedback.
- H 94 08 30 1. Nancy gives everyone a sheet to fill in that may help them create a plan.
- J 94 08 29 Nancy Journal entry - answering questions on Standards. Activities I think are do-able. I never did share these with John and Shirley.
- X 94 08 30 1. Nancy: I think the main thing about the model is that it is open to what ever your needs are. (I discuss reconnaissance, data collection and triangulation).
- JN 94 09 07 Nancy creates her first two plans. One focuses on RQ the other on introducing units with activities.
- H 94 09 08 29. Difficulties getting started at the beginning of the year because of administrative things. Nancy's class is 39, Shirley has kids coming and going, grade 8's under a lot of stress. Need time to figure out what kind of class you are dealing with.
- H 94 09 08 32. Shirley is very focused in the Sept 8 meeting compared to Aug 30.

Appendix 5: Nancy's Action Research Plans

Action Research Planning Sheet

Nancy Walton

Time line: Unit 1 - expressions
Sept 7 - Approx. Oct 7

Plan A :

To begin each unit with an activity or some activities that will introduce the use of the skills involved in the unit. The activities will usually involve hands-on work or explorative work. Assessment of activity will fall under "assignments" (10% of mark) however there will be reflection questions about the activity as well.

Problems that plan will address:

- promotion of mathematical connections
- promotion of mathematical discussion between students and between students and teacher
- make math more relevant (and possibly more fun)
- develop an understanding upon which more learning can be built

Cautions about the plan:

- must be careful to link the activity with the written work
- how can I make sure all students are involved?
- what happens if students are absent and have missed the activity

Data Collection: (journal, student work, video, observations...)

- video taping of the activity and then of written work time to see if students have learned from the activity and use this when doing work from book.
- reflection questions on the activity
- journal notes:

Reflection in journal and at next meeting

Action Research Planning Sheet

Nancy Walton

Time line Sept 7 - end of first unit

Plan A:

To assign "reflection questions" at the beginning of the class. These questions will be worth 20% of the mark. Questions will require students to reflect on previous homework assignment, on previous notes, on an activity or any other aspect of previous work. At first students will be allowed to work in pairs and I may ask them to redo their answers until every one gets a good mark. I will use a 5 scale marking scheme.

Problems that plan will address:

- promotes mathematical connections
- promotes use of mathematical terminology
- promotes reflection on learning

Cautions about the plan:

- I will have to assign less drill. Will this affect their ability to manipulate algebra?
- I must make sure I spend time on this and that I express it's value to the students.

Data Collection: (journal, student work, video, observations...)

- student work which I will share with the group
- my own journal reflections

Reflection in journal and at next meeting

Action Research Planning Sheet

Nancy Walton

Time line: Unit 2 - expressions
Oct 17 - end of second unit

Plan A :

To begin each unit with an activity or some activities that will introduce the use of the skills involved in the unit. The activities will usually involve hands-on work or explorative work. Assessment of activity will fall under "assignments" (10% of mark) however there will be reflection questions about the activity as well.

Problems that plan will address:

- promotion of mathematical connections
- promotion of mathematical discussion between students and between students and teacher
- make math more relevant (and possibly more fun)
- develop an understanding upon which more learning can be built

Cautions about the plan:

- must be careful to link the activity with the written work
- how can I make sure all students are involved?
- what happens if students are absent and have missed the activity

Data Collection: (journal, student work, video, observations...)

- video taping of the activity and then of written work time to see if students have learned from the activity and use this when doing work from book.
- reflection questions on the activity
- journal notes

Reflection in journal and at next meeting

Action Research Planning Sheet

Nancy Walton

Time line Oct 17 - end of second unit

Plan A:

To assign "reflection questions" for the last 15 minutes of the class. These questions will be worth 20% of the mark. Questions will require students to reflect on previous homework assignment, on previous notes, on an activity or any other aspect of previous work. At first students will be allowed to work in pairs and I may ask them to redo their answers until every one gets a good mark. I will use a 5 scale marking scheme. I may assign a "redo" of a reflection question instead of a new reflection question. Reflection questions will be collected on the last day of each week. In order to improve organization I will write all questions on an overhead page and number the questions within each unit.

Problems that plan will address:

- promotes mathematical connections
- promotes use of mathematical terminology
- promotes reflection on learning
- lack of student achievement on reflection questions

Cautions about the plan:

- I will have to assign less drill. Will this affect their ability to manipulate algebra?
- I must make sure I spend time on this and that I express it's value to the students

Data Collection: (journal, student work, video, observations...)

- student work which I will share with the group
- my own journal reflections

Reflection in journal and at next meeting

Nancy

Action Research Plan - Dec 5

Problem: I want to increase students' relational understanding of concepts and procedures and provide opportunities to demonstrate that understanding through written and verbal communication.

Plan:

In the past I have assigned reflection questions during class time and have not had a high return. Students don't seem to think they are important. I have tried assigning them on a daily basis but there was too much marking and too much to follow up on with the class.

This month I am going to write up the unit plan with the reflection questions as part of the assignments. I will still give students time to do the reflection questions in class, but they may also do them ahead of time so that there is lots of time to ask questions and get help. By having them on the assignment sheet I hope to have a greater return.

Once the RQ are marked I will make sure to spend 5 or 10 minutes sharing the questions in class. This should encourage some verbal communication as well as help those who are having difficulties. I will put one of the questions (or a similar question) on the quizzes and unit test to ensure that students pay attention during sharing of RQ.

Observations:

I will record my actions and examine the RQs in order to answer the following questions

- 1) Do more students hand in the reflection questions?
- 2) Is the quality of work on the RQ better than before?
- 3) Do I have time to evaluate the questions?
- 4) Am I able to follow up on RQ after they are marked?
- 5) Do students use good communication in the reflection questions and during the sharing period?
- 6) Do students demonstrate good understanding through the RQ?

Time line: I will start immediately with the grade 10's since they are starting a new unit. I will have to wait until January for the grade 9's.

Concerns:

- 1) That I will not have time or not remember to "share" the RQ answers.
- 2) That the students will not want to take time out of their work to share RQs.
- 3) That there will not be enough time for text book exercises and review of exercises, and thus students will not perform well on procedures during tests and quizzes.

Appendix 6: John's Action Research Plan

Action Research Planning Sheet

Name: John

Time line: Sept 94 to Oct 94

Plan: To use student journals in Math 8,9, and 10.
These will be reflection documents.
Students will make entries each week.
The journals will be marked and used as a quiz mark.
There will be specific guiding questions at first.
It is hoped that by the end of the year students will be doing these on their own.

Problems that the plan will address:
Keeping track of students' "understanding" of the math.
Encouraging students to reflect and take responsibility for their math learning.

Cautions about the plan:
none really
Concerns about the journals maybe

Data collection: Students Journals
Teacher journal entries after assessing student journals

Reflection: See data collection

Appendix 7: Teeter Totter Activity

$$\frac{\square\square\square\circ\circ\circ\circ}{3x+4} = \frac{\circ\circ\circ\circ\circ\circ\circ\circ\circ\circ}{10}$$

$$\frac{\square\square\square(\circ\circ\circ\circ)}{3x+4} = \frac{\circ\circ\circ\circ\circ\circ(\circ\circ\circ\circ)}{10}$$

-4 -4

$$\frac{\square|\square|\square}{3x} = \frac{\circ\circ|\circ\circ|\circ\circ}{6}$$

$\div 3$ $\div 3$

$$\frac{\square}{x} = \frac{\circ\circ}{2}$$

ACTION RESEARCH PLANNING SHEET.

Jan 3 → Feb 3

Plan:

~~Introduce the 5 level evaluation model~~

- (1) introduce the 5 level evaluation model
- (2) increase the number of reflective questions answered.
- (3) dialogue with grade 9 class about graphing equations

Problems Plan Will Address:

- (1) unclear thinking, promote logical thinking
- (2) misuse or non use of math vocabulary.
- ~~promote~~ promote effective mathematical communication

Cautions About The Plan

- (1) ~~time~~ time to mark - I may have student mark each other.
- (2) time - dir running out of it - only 1 novel left