

A CASE STUDY: A FIFTH GRADE TEACHER'S
COMMITMENT TO FACILITATING CHANGE
IN HER MATHEMATICS CURRICULUM

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CHAPTER I

INTRODUCTION

The background of this study is derived from the epistemology of constructivism, which contends that knowledge does not exist outside a person (Piaget & Inhelder, 1969). Piaget (1969-1975) describes learning as the modification of individuals' cognitive structures as they interact with and adapt to the environment. This definition requires teachers to engage students with experiences and environments, necessary for them to construct their own knowledge rather than have knowledge dispensed in a traditional way. Bruner (1978) also supports constructivism, asserting that individuals come to know the world by interacting with it and by using operational cognitive structures to explain what has been perceived.

This "coming to know" process of how we acquire knowledge has, for the past decade attracted many researchers in the field of education. A new set of considerations about teacher learning and the reflective process has surfaced. We are in the midst of multiple calls for educational change. Reformers demand that teaching focus on understanding ideas not on memorizing facts (Fullan, 1991). Interpretation and analysis would become more important than rote recall. New assessment formats ask students to participate in inquiry based tasks rather than to reproduce what they have been told. Teachers would listen more and speak less. Teachers must reflect on what they are doing in the classroom as they implement new teaching methods, strategies and content skills that alter their instruction. This change sounds simple, but as with any change, critical issues must be addressed.

Fullan (1982) states that beliefs guide teachers and are exhibited by teaching strategies and activities: which can be effective when articulation with beliefs and teaching approaches are aligned. Lighthall (1973) defined educational change as a process requiring a coming to grips with multiple realities by the people who are implementing change. While change may seem desirable to an individual, another individual may feel apprehensive about losing control or losing respect associated with a previously valued competence in dispensing content (Marten, 1992). When students are confused, for example, teachers feel drawn to “clear up” the confusion by stepping in and showing or telling. When students solve problems incorrectly, answers are rarely probed by giving time to discuss incorrect ideas, often thought to be foolish.

So, how can a system woven into our society, as in our schools, learn to remake itself around a more socially and ambitious responsible set of goals? Granted a teacher’s formal schooling, in-service training, and workshop participation all, by their very nature evidence a strong relationship between what teachers have learned and how teachers will teach (Brodkey, 1993). The difference between having the knowledge and knowing how to facilitate information still remains crucial. Feigenbaum and McCorduck (1984) state:

“One becomes an expert not simply by absorbing explicit knowledge in textbooks, but through experience, that is, through repeated trials, failing, succeeding, wasting time and effort . . . getting to feel the problem, learning to go by the book and when to break the rules. Human experts thereby gradually absorb “a repertory of working

rules of thumb, or heuristics, that combined with book knowledge, make them expert practitioners.”

This practical heuristic knowledge is difficult to acquire because experts rarely have the self-awareness to recognize it. Fullan (1991) states that change that is more deliberate and planned brings about the greatest possibility for long-term implementation. If educators can establish the basic question of how to get good at change, that is being able to recognize when to accept or reject certain changes, reform efforts will become more successful in the classroom. Moreover, learning is presumed to be social in nature, therefore, the ways in which teachers cope in new or different situations can be of significant benefit to both pre-service and experienced teachers as a powerful source of communication and possible vehicle for change. If we are to begin to have any vision of reform that can influence our American schools, new learning will need to occur at multiple levels. Meaning policy makers, along with parents, teachers, children, administrators, curriculum specialists and school board members will need to rethink and reflect on our basic assumptions and orientations about what is happening in a place called school.

Teachers have a rich repertoire of craft knowledge that when unveiled to fellow educators can be helpful to them in resolving problems and possibly altering and changing views. Consequently, how does a teacher move from competence to excellence? Metzger (1996) states it is just experience because if you expect excellence immediately, you degrade the craft of teaching. Teaching is an art form. All art done with integrity is excruciatingly difficult. Improvement often requires struggling. Rice (1986) states recent work on cognition indicates that people learn

inductively from collections of cases that describe particulars across different situations. Hence, many issues that are unsolved for educators can greatly benefit from a study that could be the impetus for insight and change.

Statement of the Problem

Researchers have suggested a number of ways in which teacher educators can help bring prior beliefs to the surface and therefore integrate them into teacher preparation and practice. Teacher satisfaction comes when a teacher's beliefs and experiences in the classroom are aligned. The intent of this inquiry was to understand why a frustrated teacher experiences a discrepancy between her practices and her beliefs when teaching mathematics. The focus was to investigate the teacher and how she adjusts and changes her classroom teaching practices to align with her philosophical beliefs. Case study was the mode for providing sufficient in-depth description (Geertz, 1973) so as to make the teacher's reality familiar to the reader. The case study represents an intensive study of a phenomenon using a variety of data sources.

A naturalistic inquiry of an interpretive case study was conducted to investigate the relationship between a constructivist elementary teacher's perception of where knowledge resides and how that perception influences her to seek changes in her teaching methods in her classroom. The goal of naturalistic inquiry is not to develop a body of knowledge in the form of generalizations that are statement free from time or context, but rather to develop shared constructions that illuminate a particular context and provide working hypotheses for the investigation of others (Erlandson, Harris,

Skipper, Allen, 1993). The purpose for a naturalistic researcher is to expand on the processes and constructed realities of one study to seek initial illumination of the context of another study.

It is crucial if we as educators want to begin to make changes that we listen to teachers in the classroom as a primary method of supporting change. Today's educators are begging for additional understanding on how to make alternative changes to resolve problems they face in curriculum deliverance. Change is a highly personal experience. Teachers who embrace change must have the opportunity to work through this experience in a way that at least the rewards equal the cost. Understanding and explaining problems teachers face is a dialectical process that play off the thetical and antithetical propositions that form the problem into some kind of synthesis (Erlandson et. al., 1993, p. 43). Therefore, this study will extend beyond the rhetoric and explore uncharted territory that requires careful attention as to what is happening in classrooms at it relates to the culture, the curriculum, the teachers and the students.

Research Questions Guiding the Study

Relevant research questions guiding the collection and analysis of the data include the following:

1. How does a teacher adjust her classroom teaching practices to align with her philosophical beliefs when teaching mathematics?
2. How does change occur?

In Chapter V questions taken from Michael Fullan's (1991) book The New Meaning of Educational Change were used as a way to concisely summarize this study.

Procedures and Methods

The case study approach is problem-oriented and can be applicable to educators. The basic rationale for a case study is that there are processes and interactions that can be studied as an entity within themselves. From this type of investigation we learn how these processes interact in one person and we will know more about the processes as factors in themselves and perhaps apply this learning to other similar type persons.

The case study approach calls for an in-depth analysis of the unit to be studied. Therefore it sets the stage for getting meaningful information. It is important that the investigation be conducted in line with acceptable practices i.e. through systematic collection on unbiased data and drawing valid conclusions. The results of the case study on a single unit may provide clues for other studies or courses of action.

The researcher will use a variety of methods. Three kinds of observations were used in this investigation: non-participant, participant and unobtrusive. The non-participant observation will involve viewing classroom teaching while sitting somewhere at a distance in the classroom. The researcher does not interact with the observed. The participant observer technique was used when the researcher interviewed the subject under study. This type of observation is also the basic technique of ethnographic methodology. This methodology also referred to as qualitative or phenomenological research allows the researcher to record the subjects in their own terms. The final method to be used is an unobtrusive observation, which focuses on things, and events that may tell the researcher indirectly something about the person being studied. Some examples to be used in this type of investigation are

teacher-made materials (such as assignments, tests, and teaching devices), the teacher's journal, lesson plan book, bulletin boards, and arrangement of classroom furniture.

Significance of the Study

A case study was chosen because it enables the researcher to provide a descriptive narrative of a teacher's struggles in what she believes about teaching mathematics and what she actually selects and uses in her mathematics curriculum over a three year period. This exemplary case study will offer valuable insights for pre-service teachers, educators, parents and possibly the general public, into a teacher's feelings, responses, and reflections as she attempts to teach according to her belief system of how knowledge is perceived. The underlying issues could therefore be nationally important, either in theoretical terms or practical terms. This revelatory case is likely to be regarded as a significant discovery with regards to the recent development of the National Board certification for teachers. Dana, the teacher under study, successfully completed this process, scoring the highest of all of her scores in mathematics after struggling for years in this subject area. The mission of the National Board for Professional Teaching Standards (NBPTS) is to establish high and rigorous standards for what accomplished teachers should know and be able to do; to develop and operate a national, voluntary system to assess and certify teachers who meet these standards; and to advance related education reforms for the purpose of improving student learning in American schools. The National Board is dedicated to bringing teaching the respect and recognition their important work deserves.

This case will focus primarily on insight, reflection by providing a descriptive text (Merriam, 1988) and will involve accessing artifacts in the form of detailed entries, observations, in-depth interviews, and examination of relevant materials. Using these research tools, questions were designed to seek understanding and meaning into the teacher's reality of the data analysis. The questions proposed would focus more on the process a teacher attempts in making change happen rather than producing a final product from change.

Qualitative research relies on watching people in their particular territory and interacting with them on their own terms (Kirk & Miller, 1986). According to Geertz (1973), its goal is to enrich human dialogue rather than to produce a formal body of knowledge. This mode of research is increasingly being used for studying educational issues (Bogdan & Bicklen, 1982) and for educational evaluation (Worthen & Sanders, 1987). According to Schofield and Anderson (1984), qualitative research generally (a) takes place in a natural setting; (b) has as its principle instrument the researcher; (c) draws upon detailed description from everyday patterns of interaction and meaning from the perspective of the person or persons being studied; (d) focuses more on social processes rather than outcomes; (e) uses several data-gathering methods, especially participant-observation and interviewing; and (f) analyses data inductively, drawing concepts from the volumes of details which comprise the data base. There is greater concern for understanding rather than knowledge as a set of axiomatic laws (Noblit & Hare, 1988).

This study should encourage educators to critically examine the process teachers experience to rationally justify and reach informed changes, along with autonomous

conclusions about where knowledge resides and how students learn effectively. For many years, learning has centered on the “end product,” memorizing names of people, places, things, dates, formulas, rules and procedures from state-adopted textbooks. Testing has been easy (Fullan, 1991). Educators were able to find out what students did not know. Schools have produced students who are functional literate, but do not have a clear understanding of what the words mean or how to solve math problems. Therefore, if change is needed it is imperative that teachers develop a clear idea of where they are going and how they can best facilitate learning to achieve excellence in the classroom in the 21st century.

Definition of Terms

Commitment according to Funk and Wagnall (1976) is the act or process of entrusting or consigning of an engagement or pledge to do something. Webster (1989) defines commitment as a pledge, promise, involvement, or obligation. Commitment refers to its relationship to an educational philosophy by providing an appropriate learning environment along with compatible methodologies in the classroom. So how do teachers come to know what they are committed to? Commitment could be described as a sense of personal identification that involves developing in students a thirst for learning. Rice (1986) suggests this powerful, driving force identifies teachers who are deeply convinced that their responsibilities extend beyond themselves.

Teachers are socialized through their own formal schooling. Socialization according to Van Manen and Schein (1979) is a process involving the way an individual acquires social skills and knowledge necessary to assume an organizational

role. Teacher socialization includes acceptance of attitudes, values, and interests of the teaching profession, in addition to learning how to teach (Lacey, 1977). Learning is hardly ever closed. As we learn something new, we are better able to meet new challenges. Learning can precipitate new problems. For many, a teacher's formal schooling may be qualitatively different from the way they learned and the way they now teach in schools themselves. Figuring out how to enhance the learning environment to its optimum is not an easy task.

The way you see something, your point of view, frame of reference, or beliefs are the lens or paradigms through which you understand your world. Sometimes our paradigms can create limitations for us. Our beliefs can hold us back. Paradigms are like glasses. The lens is how you see everything else. We have paradigms about ourselves, about other people, and about life in general. Positive paradigms can bring out the best in us. Seeing things from a different point of view can help us understand why other people act the way they do. We can experience paradigm shifts. Whatever is most important to you will become your paradigm or life center. Tough experiences can carry momentum. Setbacks can often serve as a springboard for change. When teachers encounter hard teaching moments conflict between doing the right thing and doing the easier thing occurs. These situations are the key tests; the defining moments in the classroom and how teachers handle these situations tend to shape future conflicts.

Assumptions

Numerous assumptions relating to the elementary school system for this study were made. The structural design of the school has both open and closed classrooms.

A variety of teaching methodologies is used in different classrooms. The goals and expectations for teachers, support staff, and students are similar to what most people would find in a traditional elementary school in the United States. The students' success is assumed to be reflected by the performance on achievement tests, PASS (Priority Academic Skills for Students) test and portfolio assessments given at various grade levels. The curriculum is based generally on state adopted textbooks, district approved teaching manuals acquired through various workshops offered by the school district with qualified clients presenting the newest instructional materials. The average teacher instructs by lecturing over materials covered from the state-adopted textbooks chosen by the school district.

Another assumption is that the children in the fifth grade class the teacher is instructing in are at least of normal intelligence. The researcher will assume that observations and interviews are on different days in order to experience different daily activities, and interruptions, along with the many varied interactions a teacher has during the day.

The most critical assumption is that the teacher will react normally in both behavior and performance in the presence of the researcher, who will be interviewing, observing, and studying artifacts during observations.

Limitations

There were several factors, which may have limited the results of this study. Although many hours of observation, interviewing, and studying of artifacts were spent, the researcher was limited to one to two hours' segments with the teacher under

study. Also, as stipulated by the Board of Education, no tape recorders can be allowed by the researcher in the classroom during the observations of the teacher. As a result, the discussions cannot be recorded entirely by only one researcher.

Finally, as with any research project, the element of human bias is a limitation. The researcher does know the teacher personally and will guard against discussing her own personal beliefs and philosophies and keep in view the fundamental research questions guiding this study.

Summary

This report is divided into five chapters. The first chapter presents a summary of the background and need for an investigation of this type, the statement of the problem, the research questions to be studied, the procedures, methods, definition of terms, assumptions and limitations in the study. In Chapter II, a review of the literature is discussed. The theoretical framework presented by Michael Fullan on teacher change is used as a framework for the study. The following areas were examined and investigated:

1. Instructional Choices
2. Teaching Strategies
3. Pedagogical Shifts

In Chapter III, details of the methodology and a rationale for qualitative research are presented. The teacher, the setting, the curriculum, math class, collection of data to be analyzed and research design are described. Chapter IV describes the mathematics culture of Dana's classroom. It is through the triangulation of literature research,

observations from artifacts, classroom visits and interviews that the realities are revealed about the changes that occur. In Chapter V, the summary, conclusions, educational implications and recommendations for further study are presented. Questions taken from Michael Fullan's book, The New Meaning of Educational Change are used to establish closure with the subject under study.

CHAPTER II

REVIEW OF LITERATURE

Introduction

This chapter will examine literature that is relevant to how and why teachers make changes in the classroom. Educational change is multidimensional and complex when defining and accomplishing what changes need to be made. Implementing change is usually dilemma ridden and follows a logical stage process. Michael Fullan, Dean of Education at the University of Toronto has spent a number of years conducting research, graduate teaching and in-service work on educational change. He has gained through all these experiences a clearer insight into the do's and don'ts of bringing about change. He states that if change reform is successful it must be meaningful about what should change as well as how to go about it. Experience has found it exceedingly difficult if large numbers of people are involved in the change process.

Micheal Fullan (1991) examines three components that are necessary when teachers implement changes: (1) the possible use of new or revised materials (direct instructional resources such as curriculum materials of technologies), (2) the possible use of new teaching approaches (i.e. new teaching strategies of activities), and (3) the possible alteration of beliefs (e.g., pedagogical assumptions and theories underlying particular new policies of programs). Fullan concludes that all three of these dimensions must occur for significant changes to actually occur in practice with evidence of a positive outcome. The case study conducted for this inquiry will examine how a teacher copes with and is influenced by educational change. By using the theories that Fullan offers to

explain the change processes that occur and work successfully for this teacher, other educators can hopefully identify what might occur as they attempt changes in the classroom. Specifically, this study will examine how a teacher adjusts her teaching practice to align with her philosophical beliefs about teaching mathematics. The presentation of findings in Chapter V will use questions taken from Michael Fullan's research on change.

Today's educators are faced with the task of innovatively implementing teaching strategies that students will find exciting, challenging, and meaningful. How and why we as educators do what we do in the classroom are greatly influenced by our own formal education and experiences. Schools hope to socialize and equip students with the necessary learning tools for ultimate growth and development—physically, intellectually, and emotionally. This process has been one of a traditional philosophy of education, metaphorically focusing on production, an industrial model that views students as raw materials to be molded by skilled technicians for the purposes that best fit them (Schubert, 1986). This factory model perceives students as products, which are fed information by the teacher in a dictatorial capacity.

Teachers teach for students to learn content and then formal tests are given to see if students have mastered the content supplied by the teacher. Does this style of instruction allow future adults to make informed and sound decisions for solving problems? A problem presents itself when teachers firmly believe they are providing opportunities to problem solve, but in a practical sense they are showing students how to do everything.

Historically, the scientific paradigm resulting in quantitative measurement has been the "authority" as to what truth really is. We are more concerned with people's

competencies than with their cognitive repertoires (Ryle, 1963, p. 28). If scientific evidence supports it, we accept it as face value. Typically, we do not entertain alternatives and no negotiations are possible about what is true. So is truth non-negotiable?

Guba and Lincoln (1989) in their book entitled Fourth Generation Evaluation, offer a monumental shift in the area of research and evaluation. The inquiry paradigm they describe is an alternative to the scientific paradigm called constructivist, interpretative or a hermeneutic mode of doing (Guba & Lincoln, 1989). This type of descriptive methodology attends to how things appear and lets them speak for themselves.

Constructivism provides for a proactive posture; as one recreates a particular context. Constructivists are not victims, but shapers of their destinies. They create the realities they live in by writing about the scenarios by which they play out roles. The inquiry paradigm uses interpretive or hermeneutic methodology because it claims that there are no such things as uninterrupted phenomena. The implied contradiction can be understood if “facts” of lived experience are already meaningfully experienced through language (Guba & Lincoln, 1989). Additionally, they attempt to understand the whole concept that consists of multiple realities. Each individual connected with the research has their own reality and no two individuals share the same reality.

Therefore, it must be understood in this style of research that criterion are not possible or desirable to be controlled for. Studies are conducted in a natural setting, not a laboratory. It is recognized that each context is different and when human subjects are involved it cannot be replicated exactly in another context. The researcher is interested in what happens in both positive and negative situations.

Can it be advantageous for educators to collect the “data of other teacher’s experiences?” We gather other teacher’s experiences because this allows us to become more experienced ourselves (van Manen, 1990, p. 62). Hullfish and Smith (1961) state in their book entitled Reflective Thinking: The Method of Education, “those who intend to foster thought on the part of others must understand, first, the nature of thought, and second, how their own thought has been developed” (p. 216).

Those educators, who constantly strive to strengthen their teaching strategies, must critically examine their practices in the classroom. When teachers become researchers in their classroom they deepen their knowledge by expanding their repertoire with new ideas, theories and discoveries (van Manen, 1990). Teaching requires dozens of decisions made daily, a wide body of knowledge and skill and the ability to respond instantly, often times, in difficult situations. To become proficient in these areas teachers must develop the craft calling for reflection and judgement. Experienced teachers constantly assess and adjust their classroom practice to maintain interest in subject matter, gain knowledge and skills in hopes of moving students from basic to advance levels in the curriculum. Hence, teachers regularly find themselves confronting hard choices, many times, sacrificing one goal for another. Compromising at the students’ expense can be frustrating for teachers. Choices that concern how curriculum is to be presented for most teachers are derived from prior experiences (Hullfish & Smith, 1961).

Instructional Choices

If teachers care about their instructional topic, there will be a natural inclination to display emotion and animation. If teachers do not care about their subjects it will be more difficult to produce feelings and gestures. Granted teachers can act out or invent

expressions for different occasions, but in order to maintain enthusiasm under these conditions it would become laborious and very stressful. How teachers intend to encourage in learners their values for the subject matter is very important. Once curriculum is in place for a long time, people tend to consider it the only “proper” sequence. So to omit a topic or to change the sequence of topics often involves a struggle for acceptance according to Cruickshank and his associates (1980), instructors are sellers and therefore must be advocates in their subject matter. If students can understand how the curriculum can benefit them by making a positive difference then motivating students to want to learn will occur. Teachers must have a commitment and involvement with their subject matter.

Curriculum that teachers use must be information that they care about and value. If they are committed to the subject material teachers can more easily express material in their instruction.

Curriculum content, subject to the flux of accelerating change in all areas of our society, cannot be viewed as a fixed set of goals or ideas; it must be allowed to emerge, ever changing, responsive to the human and technological lessons of the past, concerns of the present, and hopes for the future. With this in mind, no definitive curriculum can ever be recommended (NACOME 1975, p. 138).

Research has also influenced curriculum change. Research-based knowledge can be helpful in implementing change. Former studies tell us that curriculum change is a slow process often times with a tendency for ideas about curriculum innovation to be cyclic. In the mid-1970's education saw a turn away from the emphasis on structure and understanding, new content and exploratory methods that had characterized curriculum

development for twenty years. Concern about public schools then was a result of factors such as:

- 1) declines in SAT scores
- 2) low scores on portions of the National Assessment of Educational Programs
- 3) Scores on state assessment tests that seemed to mirror the lower achievement reflected on the other tests
- 4) Low performance on international mathematics tests

(Kuhns and Freeman, 1979)

As a result, the back-to-the-basics movement was a logical continuation of the movement to make schools and teachers accountable for children's learning. The minimal-competence movement arose stressing a limited body of content that all students would be expected to master. This movement paralleled the drill for the mastery movement evident in the 1920's.

Curriculum must consider textbooks. State curriculum guides present an outline that can be filled in by use of textbooks. Evidence indicates that in most classrooms teachers use a single textbook with all students, rather than using multiple sources and varying texts to suit group or individual needs of the students (Osborne, 1979). Further research also indicates that there is a firm adherence to "covering the material" in the text that teachers feel is important and delete those sections that are considered unimportant.

Research by Driscoll, (1981) indicates that textbooks do influence what is learned resulting in different patterns of achievement associated with the use of different textbooks. Textbooks provide an outline or framework on which to build concrete experiences and activities. Hence, it is important to realize that curricular concerns are

unresolved at any point in time. Curriculum is in a constant state of change. Therefore, curriculum work is a never-ending process. There needs to be ongoing assessment of the content, ways of treating the content, and the effects of the curriculum on students (Trafton 1980, p. 13).

In the 21st century the curriculum is constantly changing in order to meet societal needs. Therefore it is vital that educators work to discover better ways of teaching the scope of the curriculum content, the placement of topics, the role technology will have in classrooms and the degree of importance society places on competency testing.

Teaching Strategies

The practicality and usefulness when instructing has affected what is taught and when it is taught. Teachers who voluntarily undertake a learning project do so usually to solve a problem. Their desire to be effective in doing activities they value seem to be a strong component in their willingness to make changes (Cross, 1981). Deci and Ryan (1985) state that educators have an innate need to be competent, effective, and self-determining. These factors form the psychological basis for intrinsic motivation and lead educators to seek out and attempt challenges that are optimal for them.

Oftentimes, curriculum frameworks are viewed as too restrictive in their orientation, not allowing teachers the freedom necessary to create meaningful learning experiences for their students. Sometimes these frameworks have been described as only accountability tools used to judge teacher in effectiveness and poor student performance. Effectiveness of teaching is gauged by informal, general observation of students. Lortie (1975) conducted one of the most respected and widely quoted studies of what teachers

do and think. Lortie interviewed 94 elementary and secondary school teachers in the Boston area and sent questionnaires to almost 6,000 teachers in Dade County, Florida and he found from this study that teachers have a great amount of uncertainty and guilt about whether what they are doing has any value. Further he points to the following frustrating issues for teachers:

- 1) the isolated joys of reaching individual students
- 2) the lack of reflexivity on either an individual or collective basis
- 3) the perennial frustration of lack of time and unwanted interruptions
- 4) the complexity of the teaching act in a crowded classroom with management problems
- 5) interacting with one or more students while others are waiting
- 6) the unpredictability of a well-planned lesson falling flat

John Goodlad (1984) conducted a national sample of 38 schools including parents and teachers from these schools and found that teachers repeatedly feel isolated and alone. They lacked professional dialogue a necessary component for teacher development. A large majority of these teachers interviewed in this study said that they never observed another teacher teaching, although 75 percent of the teachers stated they would like to observe other teachers teaching in their classrooms. Goodlad overwhelmingly found there was a lack of exchange of ideas and practices across school between groups of teachers, and between those teachers in the same building.

Another study conducted by Rosenholtz (1989) reinforced what Goodlad had observed. Rosenholtz coined schools to be “stuck schools” characterized by little

attachment to anything or anybody. Teachers learned about the nature of their work randomly, not deliberately tending to follow their individual instincts (Rosenholtz, 1989, p. 208).

Hargreaves and Dawe (1989) identify two different forms of collaboration and present the struggle teachers' exhibit in the area of collegiality. In one, it is a tool of teachers' empowerment and professional enhancement, bringing colleagues and their expertise together to generate critical practically grounded reflection on what they do as a basis for wiser, more skilled action. In the other, the breakdown of teacher isolation is a mechanism designed to facilitate the smooth and uncritical adoption of preferred forms of action (new teaching styles) introduced and imposed by experts from elsewhere in which teachers become technicians rather than professionals exercising discretionary judgement (Hargreaves & Dawe, 1989, p. 7).

Pedagogical Shifts

There is very little research done on the career cycle of teachers. Huberman (1991) conducted the most in-depth study of 160 teachers in Switzerland and found that teachers go from survival to discovery the first three years, moving to stabilization in years 4-6, continuing into experimentation and diversity in years 7-18 and finally becoming more relaxed from 19 or more years. From this study, the most experienced, older teachers were withdrawn and bitter along with acting worn out.

Barth (1990) suggested a radical change in the culture of the schools and the conception of teaching as a profession. Both of these must be considered when motivating good teachers throughout their careers. Cultural change requires strong,

persistent efforts in structures and routines internalized in individuals, namely teachers. These types of changes, can be very unclear, frustrating and time consuming. Barth states it is best to assert one's leadership as a teacher, often against forces of administrative resistance, and take commitment to an educational ideal. It also requires the energy to combat one's own inertia caused by habit and overwork. It requires a certain kind of courage to step outside of the small prescribed circle of traditional teacher tasks. It is necessary to declare through our actions that we care about and take responsibility for more than the minimum, more than what goes on within the four walls of our classroom (Barth, 1990, p. 131).

No one knows what is best in the scope of educational change efforts. Educators must continually be engaged in a theory of probing and searching to understand more completely the meaning of multiple dilemmas they face in the classroom. Sarason (1971) stated that if obstacles to change in particular situations are ignored they could become harmful when finally implementing change. Sarason found that various processes might be required as one implements change causing the change agent to be able to make sense of the assumptions and guidelines necessary for motivating action. Variety in teaching strategies has motivational effects (Gage and Berliner 1984). People tend to pay more attention to things that are changing than to things that are unchanging.

On the curricular front is a shift to reassessment and consolidation. Evidence of this direction in curriculum development is indicated by recent emphasis on behavioral objectives, accountability, national assessment, performance contracting and performance-based curricula. Van Til, ed. (1971) states in his research that curricula debates will continue to revolve around change versus the status quo along with

individual dignity versus social adjustment for many years to come. In the year 2000, these issues are still ongoing and relevant. Many educators will argue that goals must be specific, while others maintain that goals can be stated in general terms. Many times specific goals get dropped while more general shifts in pedagogy provide the direction and guidance that are needed when making changes and are far more enduring. Changes must be viewed by those involved as acceptable and significant for goals to be attained.

Summary

Dewey (1933) makes the point that the immature experience of the learner is nowhere near the more comprehensive experience of the adult so that the same content is viewed by the teacher and students in two quite dissimilar ways. If the adult is unaware of this problem of knowledge and how it exists then a problem occurs that turns out to be a curriculum disaster. By studying school we can deepen our understanding of how teachers acquire the experience that encourages them to grow and change to accommodate optimal learning in their classrooms. This study will provide additional insight about what teachers experience as they reflect on making changes, how they begin to make changes, what happens when they fully implement changes and finally steps teachers take to become nationally recognized as professional educators.

CHAPTER III

METHODOLOGY

Introduction

This chapter explains and describes the research study. It will include the methodology, along with timelines to be implemented, the teacher, the setting, the curriculum, a typical mathematics class, collection procedures/data analysis, and the research design/procedures.

The focus of this research is to obtain an understanding of what teachers fully experience as they attempt changes in their classroom curriculum. Michael Fullan (1991) states that there are four main revelations or insights that appear to occur each time he has studied educational change. The following are said to not be predictable in any certain order, but over time have turned out to be important. They are: 1) active initiation and participation 2) pressure and support 3) changes in behavior and beliefs 4) the overriding problem of ownership. The teacher-researcher validates through her writing these four insights as she struggles, fails, and finally succeeds in her attempts to change her mathematical program.

The research under study is qualitative research done with naturalistic inquiry techniques. Qualitative research is rooted in phenomenology, symbolic interaction and is flexible, evolving and emergent, in design; and arrives at findings in a comprehensive holistic expansive mode (Merriam, 1988). The detail of qualitative data is obtained only by getting close physically and psychologically to the phenomenon under study. The phenomenon is a process of learning what is happening and interpreting the experience

that is mediated through words rather than numbers as in a quantitative study.

Qualitative case studies rely heavily upon qualitative data obtained from interviews, observations, and documents (Merriam, 1988). By its very nature this type of research does not adhere to the understanding that generalizability is possible. The case study is a particular research design which lends itself to qualitative research because it seeks holistic description and explanation, focusing primarily on insight, discovery, and interpretation rather than hypothesis testing (Merriam, 1988). MacDonald and Walker (1977, p. 181) define the case study as “the examination of an instance in action.”

There are several possible advantages of the case study. Case studies (1) are down-to-earth, strong in reality, and provide a natural basis for generalization, (2) allow generalizations about an instance or from an instance to a class, (3) recognize the embeddedness of social truths, (4) may form an abundance of descriptive material rich enough to admit ensuing reinterpretation, (5) begin in a world of action and contribute to it, and (6) present research or evaluation in a more publicly accessible form than other kinds of research allowing the reader to judge implication of the study for herself/himself.

To insure dependability of qualitative research results the researcher will use triangulation in this investigation. Detailed data was gathered bi-monthly from many sources. The study of artifacts from the teacher’s journal and pertinent teacher documents was examined. Also, observations and interviews were conducted to identify patterns and relationships. The researcher is identified as the instrument in the study because the researcher is the one most capable of interpretation of the data gathered. Merriam (1988) contends that qualitative research design is the most appropriate method

to study the educational setting. The relevant research questions that will guide this study include:

1. How does a teacher adjust her classroom teaching practices to align with her philosophical beliefs when teaching mathematics?
2. How does change occur?

The Teacher

During the fall, I determined what type of research I was going to pursue in my field of study. Through educator contacts, I was led to Dana who had been involved in her own personal teacher research for the last two years. Consequently, Dana was studying herself through a reflection process as she made drastic changes in her mathematics curriculum. I contacted her and explained the focus of my study and asked her if she would be interested in being my subject under study. She accepted and expressed her interests about the importance of articulating to fellow educators the impact that teachers studying other teachers have on educational reform. Because a case study is a detailed micro study, focusing on a particular individual or group, this teacher qualified as a candidate.

Dana considers herself to be a constructivist educator committed to providing developmentally appropriate practices that are necessary for students to learn. She is enthusiastic about her teaching philosophy, the teaching profession and demonstrates a sincere love for teaching children. Before the birth of her children she viewed learning as black and white. She now states that she is a much softer, more compassionate teacher and not as much a perfectionist as she was in the beginning of her teaching career.

Dana, also a researcher in this classroom, has been teaching for thirteen years, with the first six and one half years being a traditional teacher. These first six and one half years were when Dana was twenty-one years old until twenty-seven and one half years old. She was married with no children of her own at this time.

Dana was forty-six years old and would be beginning her fourteenth year of teaching in the fall of 2000. She spent nine years at home having children and raising them before returning to teach school in 1993. She had just completed her seventh year at Roosevelt elementary school. Dana completed a Masters degree in Education over a six- year period graduating in 1992.

The Setting

Roosevelt elementary school is a traditional, middle class, self-contained/open classroom school accommodating kindergarten through fifth grade with approximately four hundred and eighty students. It is one of six elementary schools located in a major university town. The school system is fairly traditional in its educational philosophy, however this particular school has several teachers moving toward progressive education. State-adopted textbooks are the core of the curriculum for most of the teachers in this building. The majority of the teachers lecture, using texts and accompanying worksheets and/or workbooks. There are approximately four teachers per grade depending upon class enrollment. There are specialized teachers in the areas of music, physical education, learning disabilities, gifted education and reading. There is a full-time counselor and a full-time librarian and library assistant who are in charge of a centralized

library. There is also a computer lab with a specifically trained assistant who works with individual classes on a part-time basis.

There is an active PTA group with strong parental support within the school, and parents volunteer often to assist in the library, helping as a teacher's assistant and with special events like the carnival, book fairs, teacher appreciation week, and other special fund-raising events. There is open communication between the principal, teachers, and parents.

Dana's classroom has six five-foot tables that replace the individual desks. Approximately four to five students are seated at each table. Requirements for seating are that both sexes must be represented at each table.

The reason Dana uses tables instead of individual desks is to emphasize and encourage community. Each student has an area in the classroom known as a cubby to store his or her classroom supplies. Students have response journals used to take notes, write personal feelings and opinions and complete assignments in which substitute for standard workbooks. Students also have a pocket folder for mathematics to keep assignments in and activity sheets relevant to the subject.

The classroom is easy to move around in so students have the flexibility of working in different areas during the day. There are pillows in one of the corner areas for students to sit on during silent reading times.

The Curriculum

The mathematics curriculum used in Dana's classroom are from the district-adopted textbooks. Traditional instruction from the mathematics textbook with occasional hands-

on activities have been previously used. Dana states she has not felt confident in how she has taught mathematics for the last few years. She recently has begun to supplement her math lessons with activities from Marilyn Burns: Investigations that a fellow 5th grade teacher shared with her. Dana states she has enjoyed these activities. The students like these activities because they relate to real-world mathematics they feel they will use later in life.

A Typical Mathematics Class

Each morning after Dana has read orally to the students from a chapter book she begins to teach math lessons. Lessons are introduced by Dana and explained. She then models through examples how to master the daily lesson to be learned. Dana further explains to the class the thought processes she uses to complete a math problem.

Students are encouraged to question, make comments and work collaboratively, in order to assimilate ideas and concepts so they can create meaning, and be actively engaged in the learning process.

Dana wants to provide as many hands-on experiences using manipulatives as possible. Students work in pairs or with their table groups. From the beginning of the school year students have been writing about mathematics in their journals, expressing their ideas and concerns, explaining how to solve problems and reflecting on what they are thinking about during mathematics lessons. Mathematics class is anywhere from thirty to fifty-five minutes each morning Monday through Friday.

Collection Procedure and Data Analysis

Artifacts in the form of written documents from August 1997 to September 2000, that include the teacher's personal journal, were studied. Additionally, the teacher's planning book, mathematics textbook, and teacher's guide along with worksheets and any supplementary resources were examined, bi-weekly during the late summer and early fall of 2000. According to Merriam (1988), data analysis involves the process of making sense out of data. It is a continual process in which findings are consolidated, reduced, and interpreted with the goal of coming up with reasonable conclusions and generalizations (Merriam, 1988). The researcher will examine journal entries extensively, probing for links and commonalities among findings.

The researcher's role for this particular study was one of observer as a participant. According to Spradley (1980), it is important that the participant observer become involved in activities appropriate to the situation, observing the people, the physical aspects of the situation and the activities themselves. It is the goal of the researcher to alternate between being an insider and an outsider to fully understand new situations and develop introspection in the course of this study.

Interviews that are commonly used in descriptive research were conducted. (Kamil, Langer, & Shanahan, 1985). The participant observer technique was used when the researcher interviews the subject under study. This type of observation is also the basic technique of ethnographic methodology. This methodology also referred to as qualitative or phenomenological research allows the researcher to record the subjects in their own terms. The final method to be used is an unobtrusive observation, which focuses on things, and events that may tell the researcher indirectly something about the person

being studied. Some examples to be used in this type of investigation are teacher-made materials (such as assignments, tests, and teaching devices), the teacher's journal, lesson plan book, bulletin boards, and arrangement of classroom furniture.

In qualitative studies, interviews allow the researcher to collect information that directly contributes to the research objectives. It provides for constant assessment and evaluation of information, enabling the inquirer to change direction, explore and synthesize (Merriam, 1988). The interview is an appropriate method for this study because it will allow better understanding of the subject's background and educational philosophy. It is the hope of the researcher that this material will provide insight for better understanding of the teacher's reality that includes what she perceives to be her present educational methodologies and philosophy, and why she desires to make changes in the mathematics curriculum.

By analyzing data from all of the sources employed, links between past, present and future practices can be verified. Patterns of curriculum choices and instructional practices were observed, categorized and analyzed in relationship to the research questions stated in Chapter I. The three areas examined were instructional choices, teaching strategies, and pedagogical shifts involved as the teacher attempts to implement changes in her mathematics curriculum. Findings relating to these areas will be presented in Chapter IV.

Research Design and Procedure

According to Eisner and Peshkin (1990), case studies are advantageous because of accessibility, allowing the research to go to places where most would not have the

opportunity to go. Case studies allow researchers to look at the world through the eyes of the researcher often seeing things she/he might not otherwise have seen. Four inherent properties of a qualitative case study are characteristic: descriptive, particularistic, inductive and heuristic (Merriam, 1988). This study will examine these properties. Descriptive study involves detailed data to be collected, recorded and analyzed. It includes many variables and their interaction over a period of time (Merriam, 1988). For this study, observation and the study of artifacts were the primary source of data collecting. Journal entries were recorded during and after each classroom visit made by the researcher. Interviews will also be conducted to gain insight into the subject's educational philosophy along with an extensive study of the teacher's journal and professional development materials.

Particularistic means that case studies concentrate on specific phenomenon, making it a good decision for practical problems (Merriam, 1988). This research will involve a constructivist teacher's reality of how and why curriculum changes are necessary and how they are fully implemented through classroom observations discussed in Chapter IV.

Inductive refers to drawing upon solutions from variables presented and is an important element to case studies. The researcher hopes to emerge from this study with a greater understanding why Dana attempted change, how those changes are understood and implemented, and how Dana moves from competence to excellence as she made curriculum changes. Through journaling the reader will be able to see the stages of change Dana experienced.

Heuristic study which provides aid or direction to a problem giving a greater understanding of a phenomenon while discovering new meanings of confirming what is

already known. Emergence of previously unknown relationships and variable can lead to new concepts for the situation being studies (Merriam, 1988). The intent of this study was to gain insight into Dana's thoughts, feelings, frustrations, and actions as she journaled, was observed, and interviewed. The case study is a particularly good means of educational evaluation because of its ability to explain the causal links in real life—interventions that are too complex for the survey of experimental strategies (Merriam, 1988, p. 28-29).

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Introduction

This chapter describes the experiences Dana encounters as she makes changes in her mathematics curriculum. It begins with a discussion of how Dana builds community in her classroom and how it influences her teaching practices.

A description of the classroom, daily schedule, materials used, and methodologies implemented during mathematics class will follow. Included in the discussion of her mathematical teaching practices will be observations relating to what the student's are participating in during math class.

The framework proposed by Michael Fullan will be used as a rubric necessary in understanding the educational changes that occur with Dana. Fullan (1991) states that the relationship between changes in behavior and changes in beliefs or understanding require total immersion into something. In most cases changes in behavior precede rather than follow changes in belief (Fullan, 1991). Commitment, socialization and paradigms and their effects on Dana and her students will also be discussed in this chapter.

Building Community

Dana teaches in a self-contained fifth grade classroom. She has 17 students, 11 boys and 6 girls. They are 10-12 years of age, with a range of 18 months. There are seven students who attend a pull-out gifted class one afternoon a week. Kyle and Shane

attend the learning disability lab daily. Kyle also attends speech therapy. Dana's students are white, with the exception of one African American. Most have been attending Roosevelt Elementary school since kindergarten. They come from mostly upper income families and from stable homes, where education is highly valued.

Dana states, "When this year's students entered my room at the beginning of the year, I noted that they were vocal, active and "me-centered" to a greater extent than the fifth grade classes I had in the previous five years. These students were shallow thinkers. They were ill at ease when discussions became deep and they often relied on goofiness as a response. My students also had difficulty listening to others; they wanted to do all the talking. They interrupted discussions by just blurting their own, often off-the-subject, thoughts. They also had difficulty accepting responsibility for their actions. I had my work cut out for me!"

Dana's students arrived in her classroom from 4 different fourth grade rooms. Because they were creating a new community of learners, they started the year by being asked what they needed to help them grow and learn. Dana accepted all perspectives as she led the discussion, and they wrote their ideas on chart paper. As they reviewed the list, they discussed what each item looked and sounded like in a classroom. From this, her students decided on the "rules" that best fit their learning community and those became their guidelines for appropriate classroom behavior. The following are the classroom guidelines the class chose:

1. We make a lot of decisions.
2. We're studying about money.
3. We read everyday after lunch.

4. We sit at tables instead of desks.
5. We work together.
6. We have the largest number of students in our class.
7. We have art every week.
8. We have 1,500 books in our classroom library.
9. We have an opportunity to be in orchestra.
10. We have a lot of fun! We enjoy what we do!!
11. We're a happy family.
12. Learning must be FUN... to stay with you.
13. Kids need to feel comfortable, not to feel fear.

On the next day they brainstormed “fabulous phrases” and “forbidden phrases”. They listed and discussed the words and body language that can either help or hurt the self-esteem of our community members. As the students listened and shared, they began to understand and consider the range of perspectives in their classroom. These discussions defined the expectations for their year together; the students knew from the start that they must be respectful of their classmates’ needs and feelings. By taking time to listen to and involve the students in creating a meaningful learning environment, Dana modeled and set the tone for future interactions throughout the year.

Dana’s community building practices have helped them grow in their abilities. She continually models appropriate responses by listening to students and by asking questions, instead of dispensing information. This supports individual thinking and acknowledges a range of voices and understandings. These techniques were evident in classroom observations. Dana often uses the mirroring technique in her classroom for

two reasons: to get the speaker to think more deeply about his/her own comment, as well as to get his/her classmates to consider that perspective.

Dana states that class meetings have been the biggest contributors to her students' growth in perspective-taking. In the beginning of the year, they used a "koosh" ball to denote the speaker; the only person allowed to talk was the one holding the koosh ball. This encourages the rest of the students to listen to the one talking. In time, they learned to *actively* listen and no longer needed the koosh ball. She often asks the next speakers to respond to the last comments made before making their own. This encourages them to reflect on their classmate's thoughts instead of just stating their own opinions, which helps develop their perspective-taking skills. One of the most important ways she helped her students develop communication and life skills, such as assertive speaking, active listening, cooperative learning, negotiation and problem-solving, was through weekly class meetings. The students know they can count on these meetings as a time to address concerns as well as plan classroom events. They begin each meeting with compliments. It is a favorite time for all of them and one that always deepens community spirit. Then they discussed issues that have come up since their last meeting. Everyone has the opportunity to voice opinions and give suggestions in their meetings. Dana's students learn to consider their classmates' ideas and to compromise, thus developing skills that contribute to the problem-solving process. This also encourages understanding different perspectives.

Further, Dana states, "Another strategy that encourages my students to acknowledge a range of voices and understanding is my classroom set-up. Three years ago, I removed all student desks and replaced them with tables. Each table seats 3-4

students. My students self-select their seating every week. Changing seats weekly exposes my students to all of their classmates' abilities, knowledge and experiences. They come to know each other's strengths and draw from them as needed. Clustering my students in small groups helps them learn to work together as friends and work together to help one another succeed. One classroom guideline I have is, "Ask three before me" meaning they must turn to each other with their questions before asking me for help. I do this so they understand that I am not the only teacher in the room; we are all resources for one another."

Dana builds a strong community in order to have a safe and comfortable learning environment for all her students. She states, "In my child-centered classroom, my students have input in many decisions that affect their education. By having them make choices about their work (for instance: choosing their own literature to read and topics to write about, choosing their own subjects to research in science and in history, and reflecting on their own work at the end of each quarter), my students take responsibility for their own learning and learn to trust themselves as learners." By having them participate as group members, she emphasizes that they are *all* teachers and learners; that everyone is an integral part of our collected learning. She lets her students know their thinking is needed and valued daily; that it is their full range of ideas and perspectives that heighten and extend their insights.

Dana feels she must prepare her students to live in a richly diverse world without the benefit of firsthand experiences because there is little economic or cultural diversity in her classroom or at Roosevelt Elementary. She knows that fifth graders, particularly this year's group, find differences uncomfortable. Out of fear, they tend to laugh at or

avoid people who are different. Therefore, she purposely chooses to teach world geography to introduce her students to cultures, languages, and traditions beyond their own. Through slides and picture books (such as *Learning to Swim in Swaziland* and *A is for Africa*), she exposes her students to the many ways people, lands, customs and clothing are different. In doing so, she opens their eyes to the richness and beauty of those differences. Dana feels that as her students grow to acknowledge and respect diversity around the world, they can more easily transfer this tolerance to the diversity they will encounter when they move to middle school next year. She enriches her students' perspective-taking skills through powerful picture books in history, too. Books like *Faithful Elephants*, *Who Owns the Sun?* and *Rose Blanche* allow them opportunities to focus on injustices throughout history, then discuss their relevance in our present day world. Not only do such activities strengthen her students' understanding of social studies, but they help them reach the goals of understanding multiple differences and considering a range of perspectives.

Over the years Dana notes that fifth graders have difficulty accepting responsibility for their actions. This year's group is no exception, in fact, they entered her classroom quite immature in this respect. She has used a variety of strategies to try to help them become more responsible for themselves, their work and their actions. At one of their first class meetings, they decided which jobs were necessary to run an efficient room and they took full responsibility for carrying them out on a weekly basis. They handle lunch count and attendance daily, as well as watering the plants and feeding the fish and bunny. Other jobs, such as distributor and messenger, give each student an opportunity to contribute to their classroom. For transgressions that occur, they decide what the

appropriate consequences should be during their class meetings. For instance, when assignments are not being completed on time, the students decided that unfinished work means a lost recess. When students began bothering others during our quiet reading time, they decided the offender loses the privilege of reading with us in the classroom during that time period. Dana always emphasizes that the consequence must fit the infraction. Her students learn to be firm, yet fair, thus honoring the dignity of the offender.

When her students get caught up in unkind behaviors toward one another, her usual question is, "What did you do to help bring this situation to an end?" She states, "my students want to respond with, "S/he did it, too!" but that type of response does not fit my question. In this way, I put the responsibility for cleaning up a bad situation right back in their laps." In due time, they come to understand that what matters is not who started it, only who ended it.

Although her students are not developmentally ready to resolve conflicts this way, Dana chooses to foster their emerging abilities by giving them this as a tool for conflict resolution. She feels effective communication skills are vital for her students in order to be successful as cooperative learners and problem solvers and she tries to help them grow in this way with every opportunity.

Constructivist Classroom

Dana's students engage in constructive teamwork developing their capacity to see that learning is continuous. Good teaching cultivates a spirit of inquiry in the classroom. Students and teachers feel invited to engage in a dialogue about the process and content of learning. In addition to admitting their inappropriate behaviors, Dana's students are

responsible for amending any harm they have caused, to others or to property. For instance, when Shane drew on one of their tables, he earned his place back in our community by washing all five tables. When a number of students hurt Alex by making fun of her thick hair (an issue addressed through a class meeting), they were expected to make amends to Alex in a way that was acceptable to her. When someone makes a negative comment about a classmate or classroom activity, she asks that the “negative aura” be countered by stating a compliment instead. Dana states that her students get playful with this one, and at the same time, realize the power of their words and learn to choose them kindly.

Class meetings are an excellent medium for discussing classroom conventions. They often check on conventions they have chosen by asking: How well is it working for us? Does it need to be altered or changed? For instance, when Ryan S. realized a decision made at a previous class meeting (about the consequences of incomplete work) was not working for him, he brought up the issue at the following meeting. He presented an alternate solution and explained his reasoning. A discussion ensued and Dana’s students voted to accept Ryan’s new proposal. Thus her students were participants in real negotiation, which allowed everyone to contribute his/her own ideas, needs and concerns in order to come up with a resolution that was acceptable to all. This is especially important in her classroom this year, where Dana’s students are still learning how to be active listeners.

Dana states “I establish a constructivist classroom where my students learn the skills of working together and where responsibilities and classroom management problems are shared, because I want them to be accountable for their actions and to treat

each other with kindness and respect. Over the course of this year, I expect my students to move beyond their egocentric worlds and consider others' perspectives. Knowledge acquisition is a process in which ideas are formed and re-formed through experiences. They will gain understandings of their own personal emotions and behaviors by hearing feedback from their classmates. This will help them develop their intrapersonal skills. They will develop their interpersonal skills through dialogue, sharing, listening, empathizing, cooperation, and conflict resolution. The more they practice these skills, the more I will expect them to grow kinder toward one another, to be active listeners and positive advocates for each other. Together we will accept and celebrate our differences, bolster each other's self-esteem, and solve our differences through dialogue."

Dana expects her students to continue to examine their behaviors and discover how they affect others. She has found that they will learn to give up the victim mentality ("S/He did it to me first!") and accept an accountability mentality. As they discover that what they feel (emotion) is separate from what they do (action), they will learn that their feelings are acceptable, but inappropriate actions are not. They will also understand that although they cannot control what happens, they can control their choice of responsive actions. They will practice alternative ways to express or deal with their thoughts and feelings. In their non-threatening environment, she will expect her students to admit wrongdoing, argue less, apologize willingly and sincerely, and accept responsibility for their actions.

Classroom Description and Math Class

In Dana's self-contained fifth grade classroom with 17 students there are seven students who attend a gifted pull-out program one afternoon a week. Two students attend the learning disability lab daily; one of these also attends speech therapy.

The students' mathematical abilities range from third grade through eighth grade. Half of the students came from fourth grade classrooms that focused on math facts and use of algorithms; the rest came from classrooms that developed math problem solvers through exploration. Three boys and two girls are mathematically strong. Nine students work diligently on math, while three typically shut down when they are lost. The male/female imbalance has made it more difficult for the six girls to claim their rightful positions among eleven verbal boys. Dana have had to be vigilant about drawing the girls into their explorations, to keep them from settling into passive roles.

Dana teaches in an open classroom, with only two permanent walls. Her classroom has five tables that seat 3-4 students each. These allow for collaborative work, which enhances student learning. She builds a strong community to have a safe place for her students to discover and explore multiple solutions to problems and to articulate their thinking. She encourages her students to extend themselves in new ways and to give input that will help others extend themselves. She emphasizes that they are *all* teachers; that everyone is an integral piece of their collected learning.

Fullan (1991) states that when people try something new they often suffer from "the implementation dip." He states that usually things get worse before they get better and clearer as people grapple with the meaning and skills of change. The following directly relates to Dana in the implementation dip. In September of 1997 Dana writes, "Deep

changes occurred within me this past summer. For years I felt like I was trying and failing in many of my approaches in teaching mathematics. I felt like a child with my nose pressed up against the window, wistfully wishing I could teach like the colleagues I admired and tried to emulate. I felt lucky that they included me into their circle, yet at the same time, afraid that they would discover I was an impostor. But this summer, during graduate class and at the OSU Writing Project anniversary, for the first time I got a sense that I *was* in the circle, that I was a piece of it. I mingled with strong teachers from across the state and came to understand that I was one of them. This new-found sense-of-self assured me of my strengths and at the same time gave me freedom to fail.”

Fullan (1991) also states that it is increasingly clear that both pressure and support are necessary for success. Pressure is not a bad thing and can become a positive influence. The following words from Dana’s journal reveal the influences of pressure and support.

“Along with this class and the anniversary, other forces came into play that gave me the boost I needed to take a leap into new territory. A colleague of mine decided I would be the subject of her dissertation about an experienced teacher trying something new, at the same time I decided to pitch my math program cold turkey and risk (who, me??) trying all new stuff in math. As part of the deal, she needs to observe me during her planning time which, coincidentally, happens to be my math time. Also part of the deal is that I communicate my thinking to her through journaling. Voila. My summer plans to change my math program and to write in a journal were forced into reality.

So I started making changes and journaling about my questions and apprehensions and ponderings and hesitations on the math stuff we are trying in class this year. For the first 2 or 3 entries, it seemed more of an assignment for completion than a tool for reflection, but that quickly changed. Now I write 1-4 times a week, at home on the computer. I write about changes I made and how they panned out in the classroom, changes I am hesitant to make and why I am dragging my feet, and changes I still hope to make and how I see them working out for the kids.

I have read and reread earlier entries and continually learn from them. I have been surprised/amused by some hand-wringing over changes that, with hindsight, seem like no big deal. Although initially disappointed by how much feet-dragging I do, I have come to understand that the bumbling and mumbling are very much a part of the process. Like Marne in the article, the journal helps me see where I have been, which in turn gives me a better understanding of where I can go and how I can get there.

So it looks like I will be researching me – how one teacher tackles change in the one subject that has defied change and remained textbook driven and worksheet graded for the past four years.”

Presently in Dana’s math class, her students create their own solutions before they ever look at math “recipes” (algorithms). Dana explains, mostly to parents, that algorithms are just short-cuts mathematicians created after they completed the important work of fully exploring mathematical concepts. She feels that if she robs her students of those same explorations, then she creates a large gap in their mathematical understandings of the algorithms. For this reason, she now chooses not to use textbooks. Instead, she encourages her students to develop their divergent thinking skills through

discovery-based activities. This year she is piloting a teacher resource book, *Investigations*, which has brought new ways of math learning to both her students and herself, which has highly influenced the way she now teach fractions, decimals and percents.

Methodologies Implemented *Then* During Math Class

Dana writes that she is unsure which is preferable: time and depth or full-breadth of curriculum? She is searching *then* for a balance. She reduced the amount of material she covered, but then worked to confine the time allotted to each so that they could get to all the curriculum that needed to be covered. The result had been curriculum that was more teacher-prepared than child-driven. Dana states she is struggling *then* to find a better balance.

Dana finds it to be very frustrating and discouraging because she only knows the algorithms she learned as an elementary student and it is very hard for her to see possible solutions. Dana knows that the more she changes as an educator, the more frustrated she becomes teaching the old way, yet she is stuck until she learns what a new way is.

As Dana began to use the *Investigations* Math series she was impressed with how the kids picked up the material so easily. She states she was slower than her students in grasping the materials because she was having to undo her old way of thinking and replace them with new concepts. The following are excerpts from Dana's journal:

Wednesday, August 20, 1997. I worked for the first six weeks of summer on cleaning out files (pitching worksheets!) and reading professional books. I read three books on using literature and writing with math, and how to teach math in different ways

than daily worksheets. It really fired me up to finally drop my program (worksheets) and take a leap into the deep end (not me! I take risks slowly and cautiously) with a new approach to my math curriculum. Yet now that those early weeks of summer are way behind me, I have lost the motivation that came from all the learning I was doing, and my fear of taking risks has crept back in.

All that I learned and was so excited about in May/June became just a hazy memory after I vacationed in July/August. This both worries and frustrates me. Do I need to reread and relearn all that I soaked up earlier this summer?? How do I get that fire back? And how is it that I can so soon and so easily forget all that was so exciting to me just two short months ago?? Note for next summer – vacation *first* – then dig into the new and motivating stuff a month before school begins again. That should keep it fresh in my brain so I will still be fired up and ready to go when the school year begins.

Monday, August 25, 1997. I am procrastinating. Not normally a procrastinator, when I do, it is a sure sign that I am ill at ease with whatever is ahead of me. We have been in school for 8 days now and I am avoiding math almost entirely. Oh, we have played with numbers in various ways through math games and puzzlers that stretch the brain and bring about new views of mathematical concepts. Hmm... “playing with numbers” is exactly what I want to move into for the bulk of my math program. Hey! this tells me that what we are already doing as “play”, is what I hope to do as curriculum. I may be closer to what I want to be doing than I thought. I just have to do those beginning-of-the-year type activities every day. Wonder if it will be as easy as it sounds...

I did try one new activity that was most fascinating. It was part of our science exploration of coins. While working with pennies, I asked the kids to measure the height of a dollar's worth of pennies. No table had 100 pennies (each child had 15), so I knew they had to attack the problem differently than measuring a stack of 100. I traveled the room as they worked individually or in groups at their tables. (5 tables have 4 students / one has 5) They came at the problem in various ways and were intrigued by the task.

One thing I found interesting was the many elements of math that came into play – millimeters, centimeters, inches, fractions, adding, multiplying, problem solving. Obviously, I have not taught any of these yet this year. But they were learning what they needed to know right then and there *because they needed it and wanted it*. I have known and understood this “need to know” concept but have not seen it played out very often. One thing that really got drilled in to me this summer in all my reading was to *create* that need to know.

By tossing out a problem that interested them, the “need to know” was there. I was able to teach some big-time math concepts to ready minds through short conferences because they needed to know those particular concepts to complete the task. As I circled the room, I addressed all the fore-mentioned elements of math. The kids soaked up the information and questioned me until they understood what they needed to continue.

The other thing that was so fascinating was seeing the many different ways they attacked the problem. Again, this was a live display of what I had learned through my summer readings (books by Marilyn Burns). One child measured how many pennies it took to reach one centimeter (7) but then was stuck as to what to do with that information. A number of children measured ten pennies and then multiplied that

number by ten. One child worked entirely with decimals, and advanced-level skill. Many of my individual lessons were on measurement. (“What are these tiny marks here??” / “If this mark is smaller than an inch, what is it called?”) Normally when I teach markings on a ruler, the kids have difficulty keeping them all separate; today my explanations made sense to them. I presume this change came from that ‘need to know’ – from having a real reason to possess the information.

Wednesday, August 27, 1997. I am stalling still. Much of my hesitation comes from *my* need to have a full picture in mind of where I am and where I am going with the material. I am most comfortable when I have carefully examined as many resources as possible and made my lists of poems, books, songs, videos, puzzle sheets, etc., that complement, enhance and enrich the unit. Then I am ready to plunge in and start the unit, drawing from the resources I have collected when they fit what we are doing within the unit. (OK, so call me analytical – *anal* for short!) The task is huge but always well worth all the work. But right now the idea of pulling all that together for the subject (math) is overwhelming to me. So instead I procrastinate, and grow more frustrated as the days go by from my own lack of action.

What I really want to grow into is what all my favorite colleagues/friends do. These teachers are all big time risk-takers and very spontaneous in their teaching – my opposites, which is why I hang with them. I learn so much just being in their aura. They hear about an activity one day and use it the next, or they pick up an idea that morning and use it the same day. Not me, I have to plan and muddle and plan some more and research and then schedule it in so it blends and integrates across the curriculum. Many

great ideas never get carried out because I am still muddling with them, trying to build a whole curriculum around each.

So what does this all mean? To my surprise, writing this down has helped me see that I am doing some good things after all and that I just need to loosen up and go out on trust more often. More importantly, that maybe I *don't* have to have a complete curriculum built around each math activity we do! So here is my plan: I have a stack of great ideas I gathered this summer and I am just going to start in on them. I will pick one up and do it, even though it has not been integrated into the rest of the day or has an accompanying read-aloud! I am tired of having my feet planted in cement.

Friday, August 29, 1997. Bit by bit I am venturing out and it is going well. Today I read *Pigs Will Be Pigs* aloud, a somewhat low-level money/math picture book. Then I came up with an idea: I distributed menus and rolled dice to get 4 numbers. The kids could put the 4 numbers together in any order to create a dollar/cents amount. Then I told them to “take 3 friends out to eat with you”. They had to write down their orders and total bill, with the goal of getting as close as possible to their recorded dollar/cents amount. They really enjoyed this activity, especially those kids who created a large dollar amount (ie: \$75.20) or a small dollar amount (ie: \$07.25). The kids were able to work with calculators, which created more impromptu lessons, mostly on the use of decimal point. At the end, I had them write either how they had to choose the food items to meet their designated money amount or what they learned from this activity.

It was fun to watch them so on task for a full 45 minutes, absolutely 100% involved in the work. As I do more of these type of activities, I am learning to do more of my teaching on a one-to-one basis, as needed. I worry still about the noise level, but not as

much as I used to, probably because I am adjusting to it and I hear so much learning going on through their talk. I also worry about the needs of the parents, as math computation is a big concern of theirs. I need to remember to carry out my idea of a few problems every single day....that will give the kids computation practice, but still give us time to explore numbers in new ways.

One of the things I really like about just pulling an activity out of my stack and going with it, is that it always involves many aspects of math. In the past, I would categorize all math activities by units, then do those activities during the accompanying unit, making sure certain concepts were taught first. But the activities I am using now bring in a wide assortment of mathematical thinking and computation, stuff I haven't formally taught. Yet more is being taught and learned through carrying out the activity, than when I follow my stair-step curriculum.

Monday, September 1, 1997. Oh boy – what I will write now is probably going to negate that whole last journal entry. I spent most of my Labor Day weekend pulling together 3 small math units and their accompanying activities. (graphing/ place value/ decimals) I tried hard to cull my worksheets, but it was not easy. I have pared these down several times already in the past years, so I really am down to the basics. This time I cut and pasted “worthy” problems from worksheets and eliminated the junk. I also pulled in new worksheet/activities that I have Xeroxed from *Intermediate Mailbox*, a teacher magazine. Each time I tried to narrow down the number of worksheets even further, I would get second doubts.....Will I really cover this material through the mathematical explorations we will be doing?? I know we will be doing some great mathematical thinking and problem solving, and that computation will be an integral part

of arriving at some solution....but what about all those incidental pieces of information...will they show up also?? As my doubts crept back in, so did the worksheets. I have really pondered hard on this one for the last ten days. This weekend I comprised on my original dream of using few to no worksheets – to using some “solid” worksheets as verification of concepts learned from our explorations. Does that make me a wuss...to give in so easily and so soon?? I have already seen that exploration is fascinating and fun and full of learning. But how does one measure that? If we could forget the report cards and instead spend our time on exposure – I know I could guarantee growth in all my students. But it wouldn't be measurable, not that our present system measures all that much. So wrestling with the issue of who-knows-what-and-who-doesn't brought me back to some form of a measurable system; ie: worksheets.

Bummer.

I soothe my sorry ego (“You're a quitter!!” I hear my other-self taunt) by assuring myself that these worksheets cover the material well, without too much frill or drill, and that I truly have narrowed them down to the few best ones. And I know I will carry out my original plan to bring literature and writing into math, as well as continue, and add to, the mathematical explorations we already do. But my lofty ideas about building a math curriculum solely around those is just now enough. I need concrete evidence of who can do what (as well as some grades) and this is an efficient way to get that information. So here I stand at a compromise: explorations, discussions, literature, and writing during class time / computation practice for homework. Though not my original plan, it still is a welcome and positive change from last year when I (ooh I hate to admit this) taught the concept from the front side of the worksheet, and then the kids completed the other side

on their own. Back to professional growth in baby steps. Oh well, at least it is growth.

Wednesday, September 3, 1997. It is important to send students into disequilibrium in order for them to learn. Which is exactly what I need to do with my students – toss a problem out that puts them off balance – and then they have a quest – to get back into equilibrium, to set their world right again. This is easy to do in math. So why do I put such faith in math worksheets when I have tossed out texts, tests, and worksheets (and even grades) in all other subjects? I know one reason why. Building a curriculum is a huge task; one I have tacked in all other subjects. It has been kind of nice to be “released” of this enormous job in this one subject area. Also, worksheets are easy to grade, easy to get grades from, and give a fast, objective picture of what the child can and cannot do. But do they really give me or kids or parents a realistic picture of what the child understands mathematically? More to ponder.

Friday, April 24, 1998. *Investigations* continues to be a wonder to me. I find it ironic that I spent this whole year trying to build just such a program on my own, piecemeal. In spite of a plethora of math idea books, I couldn't build my own unit because I didn't know each concept's mathematical possibilities, nor how to carry them through. The activities I did try from those books (using children's literature / using manipulatives / using “quests” / ...) were all wonderful. The problem with them was that each stood on its own as a single activity. I could find no series of activities in those books that built on themselves, that carried us through a whole concept from beginning to end.

The *Investigations* unit does exactly that. It builds and builds on itself, all the while requiring the kids to use critical thinking and writing as tools for working through the

investigations. I never could have put together such a unit, but it is exactly what I wanted my math program to be, and what I was trying to pull together this whole year.

Commitment and Instructional Choices Implemented During Math Class Now

Dana knows her fifth graders learn best when their prior knowledge is activated, when they are invested in the topic, and when they can apply their learning to real life. For a real life learning experience, she invited a dietitian into her classroom. Together she and her students explored nutritional needs and examined balanced diets using the food pyramid. Their discussion reinforced her students' prior science learning on the human body and gave them a "need-to-know" for the subsequent activity, calculating percentages of fat content in food items and meals at McDonald's. This activity also exposed her students to reading labels, and gave them opportunities to examine what they eat and in what ways their diet might need some changes, all good life-skills.

The dietitian's talk raised many questions about their own diets, which was a perfect lead-in for the next activities. Dana's students examined food labels collected from home to determine their fat percentages. They deepened this understanding by listing their typical McDonald's lunches, then calculating the percentages of fat in them. These activities generated high interest levels among the students; they were both intrigued and appalled to discover the different percentages of fat in the foods they eat. It also gave them opportunities to develop and apply number theory concepts in a real-world situation. Dana feels this helps them appreciate math as a body of knowledge rather than learning isolated facts. She normally states that, learning how to turn a fraction into a decimal and then into a percent would be irrelevant to her students, a

meaningless series of computations. Instead, these computations became a means-to-an-end; necessary tools for addressing their questions about their diets. This activity provided learning with a purpose. These activities provided learning with a purpose and also gave the students an awareness of food labels and fat content that they previously did not have. This life skill empowers them to take responsibility for their food choices and daily dietary needs.

Fractions, decimals and percents are a large focus of the fifth grade curriculum, as mandated by state guidelines. Dana feels her students need many concrete and relevant activities, plus time to explore and discuss them, in order to assimilate new mathematical ideas. Therefore, she choose the whole group discussion on clock fractions because it gave her students an easy and highly visual way to understand and practice equivalent fractions. It centered on a class discussion about equivalent fractions using a large clock with moveable hands. Since the transition from one fraction to its equivalent can be difficult for fifth graders to “see”, the whole group discussion and use of the clock manipulative helped them visualize and practice this concept repeatedly. It also promoted communication about mathematics, a necessary element to help build mathematical thinkers. The activity addressed this important concept in a simplified and fun manner, relieving any math anxieties that might otherwise arise. It also gave the students an opportunity to play with a concept repeatedly and experience success.

The following is an example of how Dana is committed to personalizing the students' learning to meet his needs as shown in the following excerpt. Will is a fraternal twin; his brother is in the fifth grade classroom next door. Will moved here at the beginning of this school year from a small town in our state. Will is extremely shy; he

has not yet initiated a conversation with Dana and usually responds to her questions with nods of his head or very short answers. He seems comfortable with his classmates, in the classroom and on the playground, although he is not verbal with them either. Dana worked all year to make sure Will feels safe and at ease in her classroom, so that he can open up to us freely and comfortably. He will now raise his hand to answer questions, but still does not ever call out answers, as the rest of my students tend to do. He is just beginning to add comments to their many discussions.

Will comes from a small school where he was a straight A student, yet his learning is all “textbook”. He knows rote facts well, but has difficulty discussing or applying them. It is apparent that he has not been exposed to the higher order thinking that we do as a matter of course in Dana’s classroom. Will is a perfectionist with his schoolwork and becomes quite frustrated when he fails at something. Unfortunately this, coupled with his shyness, creates a problem. When he does not understand an assignment, instead of asking for help, he continues working. This means he usually goes off in the wrong direction, thereby completing the entire assignment incorrectly. Dana states, that it took her a while to figure this out; now she makes a point of checking on his work more regularly. As she roams the classroom, she no longer accepts his nod of “I’m OK” to be an accurate statement of his comprehension level. Her challenge with Will is to catch his errors before he gets too far into his work so he can complete the assignment successfully. At the same time, she feels it is necessary to continue to encourage him, hoping that one day he will feel safe enough to risk asking for help more readily from her or his classmates. The final part of this activity involved creating a lunch and calculating

its fat content, was completed successfully. Therefore, this assessment told her Will developed good understandings of the computational process.

Will sat at the same table as Kyle the week they did the dietician's assignment. This turned out to be a good thing for both of them. Kyle just naturally checked on Will and helped him along, even though Will did not ask for help. Yet Will was a willing recipient of Kyle's commitment, which increased Kyle's confidence and Will's mathematical understandings. Kyle's help is evident when he showed Will that he had copied the macaroni and cheese numbers incorrectly, thus causing all further calculations along the row to be in error. Will tends to plug forward without checking his work to see if his answers make any sense. Dana was glad Kyle was there to check on Will. He was less embarrassed when he was corrected by a classmate than by her.

Will was quiet throughout the discussion about choosing titles and ranges for the three columns of food items. Dana watched him closely as he completed the listings which gave him no difficulty. Will's written observations during this activity showed Dana that he still had not moved to deeper levels of thinking and reasoning in his work. Although his observations were accurate, they are merely visual observations. Will made no inferences from his findings, nor drew any conclusions. For the first activity sheet, Will chose to complete the first three columns before starting his calculations. Dana writes that she revisited his table when he was at the top of the fourth column ("fraction"), and noted that he was making the fractions incorrectly (i.e.: 80-100 instead of $80/100$). This verified for her that Will not only misunderstood the content at times, but also that he had no clue that he does not get it. She reiterated the reasons for dividing the total calories by the fat calories and showed him what that division problem looks like

as a fraction. He corrected those two and continued working. She checked back in with him several times over the course of this task and noted that he was progressing nicely. Dana further states that Kyle, in a very confident mood, was narrating each step along the way, which greatly benefited Will.

Studying fractions, decimals and percents together helped Dana's students build their number sense on a very deep level. From repeated exposures to the relationships between these three, they understand that 0.05 is not at all the same as 0.5, because they know that 0.5 is $\frac{1}{2}$ or 50%, and 0.05 is only $\frac{1}{20}$ or 5%. Knowledge of these relationships on this deeper level helps them estimate answers and catch computational errors, because they know what to expect about the size of a number. The students also developed strong concepts identifying equivalent fractions, evident from their active engagement in the discussion and from Dana's assessments of their understandings in the subsequent weeks.

While the next assignment, calculating percents from fractions and decimals, appears to be a huge conceptual leap from the first assignment, her students had worked with fractions, decimals and percents at increasingly more difficult levels in the weeks between the two assignments. They were, in fact, quite well-prepared to understand and tackle harder concepts. They were also engaged and successful in this meaningful real-life activity. They calculated the fat percentages from caloric listings with great interest and ease. When her students figured out the fat content food items in their homes and of a lunch at McDonald's, it gave them a better sense of how the different types of numbers are actually used in life, as well as in mathematical contexts. Their knowledge of these concepts was personalized. Dana states that she would never have believed fifth graders

could handle such concepts before she began piloting the new math resource book this year. From the activities they completed, she assessed that they met and surpassed her original learning goals.

Dana concludes that although it has taken what feels like a very long time, her students have begun to understand and consider perspectives other than their own in problem solving. For instance, while her students learned early on in the year not to talk while it was someone else's turn to talk, they still were not good at *active* listening. Instead, they carried on monologues, saying what they wanted to say instead of extending someone else's ideas and opinions with their own. Traces of these behaviors are still evident throughout the year. Yet for the most part, Dana's students are becoming budding conversationalists; they are able to comprehend one person's ideas and add to them with thoughts of their own ideas as they work through mathematical problem solving.

Teaching Strategies and Socialization

Mathematics educators believe that too much of traditional mathematics instruction has been conveying information from teacher or textbook to student. The teaching strategy implemented has typically been the teacher or the textbook attempting to give knowledge to the student rather than encourage the student to construct knowledge on their own. Students are taught methods of doing problems without being taught why the methods work. There is too much memorization of math facts and procedures. Dana contended that she previously has taught math in 20 to 60 minute segments, rather than as a useful part of life, with few attempts to map mathematical concepts and procedures to real-world relationships.

Presently, the eight-week math unit introduced in Dana's classroom was on fractions, decimals and percents. Her instructional goals *now* were for her students to develop concepts of and number sense for fractions, decimals and percents, to use models to explore operations on fractions and decimals, and to apply fractions, decimals and percents to problem situations. These goals came from NCTM Standards. She wanted her students to investigate relationships among fractions, decimals and percents in order to create a richer understanding of all three. She also wanted them to be familiar with them as quantities, so their strategies for doing computation with fractional amounts would be based on that knowledge.

The first learning experience, finding equivalent fractions, took place on the sixth day of the unit. "At this point, the students were to not only learn how to make equivalent fractions, but primarily to be able to "see" them, to conceptualize them at a deeper level, beyond computational algorithms," Dana states. The second learning experience, calculating percentages from fractions and decimals, was in the seventh week. Its intent was for the students to have the opportunities to experience real-live application of these mathematical ideas and concepts, and to use calculators as mathematical tools. Between the first and second learning experiences, Dana's students learned to add and subtract like and unlike fractions and mixed numbers, compare and order fractions, solve word problems using fractions and percents, and interpret decimals. These learning experiences expanded the students' math horizons to include fractions, decimals and percents, and helped them understand common ideas underlying these number systems. From these experiences they began to understand and appreciate the need for numbers beyond whole numbers.

Another teaching strategy Dana employs is to have her students complete an activity sheet on clock fractions because she wants to have the opportunity to assess students' individual understandings after a full group discussion on a particular activity. Although it often appears that her students are following along just fine as she guides them through a discussion, experience tells her there are at least a few who are lost. Therefore, this activity provides her with a quick assessment of who is able to transfer their learning to paper. She is also able to assess their individual strategies for finding answers to problem solving.

The following is a narrative written by Dana of the teaching strategies she uses *now* and what occurred with her students. "I began by asking my students to name fractions for what hour the clock hand represented *out of* the number of hours on a clock. By using the same phrasing as day two, I reinforced the concept of identifying fractions. Although using a clock to identify fractions was new to them, my students caught on quickly and explained their reasoning well. For instance, when I asked what to call the fraction marked by the 1 (o'clock), Skip immediately named it correctly as $1/12$. He knew it identified one part out of 12 because of our previous days' discussions. When I asked what fraction 3 marked, I thought my students would follow Skip's logic of dividing the clock into twelve parts, thereby naming it $3/12$. Instead, Ryan S., Ryan A. and Candace automatically saw it as $1/4$, and explained their reasoning: "Because $15+15+15+15=60$ " / "You can tell by how much of the clock it covers." / "You can think of it as a pie." My students are comfortable sharing multiple solutions to an answer."

"Alex made the connection to $3/12$ stating, "If it's at the 1, it's $1/12$ and 2 is $2/12$, because it's 2 of the 12 hours". Up until this point, I was directing my students' attention

to fractions with the denominators of 2, 3, 4, 6 and 12. Before I had the chance to ask how many *minutes* the clock hand represented out of how many minutes on the clock, T.J. made that mathematical leap by identifying the equivalent fraction of $15/60$. I followed his lead and allowed my students time to explore equivalent fractions with 60 as the denominator.”

“The concept of naming equivalent fractions became easier as my students continued to identify them and justify their answers. The discussion picked up tempo. Taylor said $8/12$ was $40/60$ “because it was $15/60$ ” making the connection back to their finding of $3/12$ (hours) as the same as $15/60$ (minutes). When I asked why the chart named $8/12$ as $2/3$, they all wanted to explain it to me. Julie’s reasoning, “4 goes into 12, 3 times”, proved that she understands the clock can be broken into three sections, with 8 at the $2/3$ point. T.J. initiated a new idea by asking, “If it’s on the two, wouldn’t it be $1/6$?” He justified this by stating, “If you count two numbers as one, and there’s six...” meaning every two numbers represents one sixth. Dana then asked them to identify all equivalent fractions as she called out clock numbers. Her students gave her rapid-fire answers to the numbers and to her request, “Can you say it another way?” These rich exchanges exemplify Dana’s students’ reasoning abilities and understandings.

Several exchanges clearly demonstrate this classrooms productive, open and enriching learning environment. Some of these involve effective questioning techniques. For instance, when Dana’s students give answers, she usually ask, “How do you know that?” or “How many of you agree?” She does this so students have to clarify or justify their thinking. When she continues to ask the question, “Can you say it another way?” even though her students have given her all possible answers, there is a pause. Then

Ryan A. pipes up with “There aren’t anymore!” She questions this way often and on purpose. If she lets on there are no more possibilities by not asking for more then her students are not being asked to test the limits of their reasoning abilities, Dana states. She also makes a point of rarely answering students’ questions. Instead, she addresses their questions back to them or to their classmates. She feels this prompts her students to seek their own answers, or at least develop some hypotheses about them. This is evident when T.J. asks, “Wouldn’t it be $1/6$?” and she states, “Somebody answer T.J.’s question”. When D.C. goes to add a fraction to the Equivalentents Chart, she responds to his query, “Where do I put it?” by stating, “You tell me!” Likewise, when Julie asks where to write $20/60$, Dana turns to the class and says, “Tell her where to put it”. Dana also lets them do all the chart-writing to give them ownership of the content and to affirm their roles in their classroom.

At one point when she asks, “What is $1/6 + 2/4$?” Alex stands up by the clock to explain, “First I put the $1/6$ to the side for the moment. $2/4$ is obviously $1/2$. And if you go to $1/6$, that’s the 2.” Dana demonstrates by moving the clock hand two numbers past $1/2$, which is $2/3$. Kyle jumps in with, “I know another way!” and goes on to explain his route to the answer. This exchange shows that her students are comfortable explaining concepts in their own way, and with sharing multiple strategies to arrive at a given answer. Dana encourages her students to try several strategies that make sense to them and applaud their efforts, even when they are mistaken. The more they share their thinking out loud, however erroneous, the more readily new ideas are provoked into existence.

Dana admits at times she must decide when to step in and provide the information and when to allow my students to struggle with it. Dana states that it is very important for her students to encounter disequilibrium when discovering new concepts. She feels that as she and her students “muddle” through problem solving in mathematics they will develop into more self-confident learners. This happened when Taylor states, “It can be $10/6!$ ” She waited a moment and he corrected himself with, “Oh no it can’t – never mind!” However, when Ryan S. says 8 on the clock represents $2/3$, “Yeah, ‘cause it’s half and half and half,” Dana steps in with, “Whoa! Think that through again, Ryan!”

Dana’s classroom is open and accepting of all learners. For instance, when T.J. is confused and Emily understands, Dana asks Emily to turn to T.J. to explain what she knows. She does this to emphasize that she is not the one with the answers, that we are all teachers and learners. Other effective strategies she uses to enrich her students’ learning are also evident. For example, after Luke explains how he knew that the clock hand on 9 represents $3/4$, she acknowledges his thinking with, “You’re using the information you already had and built on that!” In this way she helps students develop their metacognitive skills.

Pedagogical Choices and Paradigms

Kyle is the fourth child in a military family of four boys. He is friendly and talkative, a loving and generous child who is eager to please. Kyle has immature behaviors, more typical of a third or fourth grader. He does not have any close friends in the class, mostly because he cannot keep up with his peers socially. He is easily discouraged and, earlier in the school year, would cry when he was frustrated.

Kyle was diagnosed as learning disabled in fourth grade and began attending the LD pull-out program. This year he attends LD class for 30 minutes every day and speech class once a week. He has had private tutoring for three years, in both reading and writing. His reading is now on grade level, but he still has great difficulty with writing. He is very literal and does not make connections easily. Kyle generally tries hard on his schoolwork, but because of his difficulties, sometimes lapses into avoidance behaviors. Dana has had to be in regular contact with his parents about his homework; because he often “forgets” to do it. Because of his low maturity level and continuing need for private tutoring, his parents decided to retain Kyle in fifth grade this coming school year.

Kyle’s one area of strength is math. He grasps mathematical concepts somewhat easily and is comfortable manipulating numbers. These abilities, though not top-of-the-class, are a boost to Kyle’s low feelings of self-worth. They give him opportunities to shine, as well as some status in his peer relationships. Dana writes that her challenge is to take advantage of Kyle’s math strengths to bolster his self-esteem and confidence levels. By doing so, she encourage him to transfer this positive view of himself as a learner to his other areas of study.

In the following activity, you can see how Kyle’s self-esteem is enhanced. Kyle listed the total calories and fat calories from the ten nutritional labels selected by him and his table-mates. He created fractions from those numbers, and using a calculator, divided the fraction to find the decimal. This involved rounding, a concept the class revisits each time they use decimals. When Kyle’s calculator read “0.2307692” as the decimal representing the fat content in Cinnamon Toast Crunch, Kyle knew to round this to 0.231. Likewise, when the decimal representing the fat content for Poptarts was “0.1315789”

and Kyle correctly rounded this to 0.132. Kyle converted these decimals to percents and did not have difficulties with any of these operations. In fact, he was comfortable enough with his understandings to be able to explain the procedure to his table-mates as they worked together on this activity.

In the second part of this assignment the class discussion was on breaking the forty foods (ten each from four tables) into groupings by fat percentages. The students had to collectively agree on the titles and fat percent ranges in which to list the forty food items. Because of their visit with the dietitian, they knew that 30% is the upper level for daily fat allowance, therefore, they chose the 0-30% range and title, "OK Fat", for the first column. Debate arose over labeling the next two columns. Some students wanted the ranges to be equal in size; others argued for the ranges to more closely represent the food items they intended to list in each. Kyle's conclusion, "Everything over 30% is too much fat", helped the class determine the next two groupings. Although Dana was one who had previously believed the columns needed to represent equal ranges, they all accepted Kyle's argument for creating the second column: "Fat" at 31-50%. This made the third column an easy decision at 51-100% and "High Fat". Next, Kyle worked with his table-mates by sharing his information as they all listed the foods in the appropriate columns. The five patterns were good starting points, but they were incomplete. This exemplifies Kyle's low reasoning skills. He took the instructions at face value and did not attempt to make any connections to understand why the patterns are what they are.

For the final part of the assignment, Kyle examined his eating habits by reactivating prior knowledge about calculating percents from fractions and decimals. Using a nutritional menu chart from McDonald's fast food restaurant, Kyle recorded a typical

lunch he might eat. He listed the total calories and calories from fat in the appropriate columns, then converted these numbers to fractions and calculated the decimals. Again he rounded the decimals correctly, converted these to percents, and transferred the percentages to the circle graphs accurately. Through all of Kyle's work, it is clear his conceptual understandings of fractions, decimals and percents are solid."

Dana gives positive feedback to Kyle often and verbally, so that both he and his peers benefit and acknowledge his abilities. This was easy to do with these assignments. For the most part, Kyle completed all four activity sheets with ease. He was an active participant in classroom discussions on the content and helpful to his table-mates when they got confused. Dana encourages these roles in Kyle so that his confidence and feelings of self-worth will grow.

Dana's only concern about Kyle's work stemmed from the third activity sheet. Kyle was to list patterns he observed about the kinds of foods that were in the three columns. Kyle noted that most of the food items fell into the "OK Fat" column, but did not connect this to any understanding he might have about these foods or about low levels of fat content. During this activity, Dana roamed the room to observe, ask questions and give feedback to her students as she assessed their work. When she stopped to chat with Kyle about his observations, she asked him why he thought so many foods were in the "OK fat" column. His answer was immediate, "Because lots of people want to lose weight and they [companies] think they can make more money if they make low fat foods for those people". Kyle's quick answer reminded her that he is a good thinker but that writing his thoughts is difficult for him.

Since fractions, decimals and percents are a large focus of her math curriculum, Dana plans to incorporate more time to explore and grapple with those concepts to help her students develop deeper understandings of them. She also wants to extend fractions, decimals and percents into the area of graphing. Her students will have more opportunities to play games to further promote mathematical understandings.

To conclude, she will incorporate more assessments, both formal and informal, in order to better see gaps in both teaching and learning. But most importantly, she states she will seek new ways to connect their mathematical work to meaningful, real-life situations in as many ways as she can. Dana states she wants them to see math not as a “school subject”, but rather, as a significant tool and necessary life skill.

CHAPTER V

SUMMARY, CONCLUSIONS, EDUCATIONAL IMPLICATIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to examine how a teacher adjusts her classroom teaching practices to align with her philosophical beliefs over a three year period was studied. The intent of this research was to generate a broader and deeper understanding of the processes teachers experience as they embrace changes in curriculum choices and implementation.

In order to fully understand a specific phenomenon a qualitative, case study approach was selected. A case study is strong in reality and lends itself well to in-depth study of individual or group within a limited time frame. It begins in a world of action, emphasizes process, and provides natural hypotheses for investigation of others. It is, therefore, appropriate for this research design. It is vital if educational change is to occur it will require that teachers first understand themselves in order for other teachers to learn and understand from them. As one can see from Dana's journal entries there was a discrepancy between what Dana believed to be appropriate practice in teaching mathematics and what she actually engaged in with her students in the classroom for a number of years.

The period of study of artifacts, in-depth interviews, and observations covered a three year period beginning in August of 1997 and ending in September 2000. During

that time, study of artifacts such as the teacher's journal, lesson plans and curriculum materials were studied along with observational visits of the teacher in her classroom.

The study focused on 1) commitment and instructional choices chosen by the teacher 2) teaching strategies and socialization factors implemented by the teacher 3) pedagogical choices and paradigms facilitated by the teacher. Dana, the teacher under study, also assumed the role of researcher. By studying their students, teachers can bring the academic findings down to a practical level and discover what works in a specific situation. Journaling and reflection by Dana produced a determination to make a commitment to implement curriculum changes – changes she felt strongly about because of the discrepancy she felt when teaching mathematics between her practices and her beliefs. Clearly the reader in Chapter IV can establish from Dana's experiences in the classroom what Fullan described as the four main insights that repeatedly occurred as educators attempt change. They are active participation, pressure and support, changes in behavior and beliefs and an overriding problem of ownership in this process. Dana concludes that each day she tries new approaches to math instruction she feels more certain she is on the right path. As her confidences increase she no longer spends math class totally on worksheets. That time is now used, for the most part, on discovering solutions to interesting questions. Computation is becoming a by-product, not to be used as an end all. She sees that the relationship between behavior and belief change is reciprocal and ongoing as she makes breakthroughs in meaning and understanding.

Over the three year period, Dana developed and continues to develop a rich understanding of the mathematics she teaches and has gained a greater appreciation of how knowledge in this area is created, organized, linked to other disciplines and applied

to real-world settings. Fullan (1991) states that deep ownership of something new is not acquired easily to begin with and that one may not know what they are doing initially. He finds that ownership is a progressive process that requires clarity, skill and commitment that if successful comes out in the end as a positive change process. It is evident by the instructional activities the teacher under study chooses in her classroom that she is developing the critical and analytical capacities in herself and her students. Dana's quest for how to effectively convey and reveal subject matter (math) to her students has been and continues to be a challenging journey.

Conclusions

Over the duration of the three year period from August of 1997 to September of 2000, Dana struggled with trying to align her teaching practices with her philosophical beliefs. Her quest to help her students construct a more accurate representation of mathematics and develop more mature thinking patterns was evident by the types of activities she chose in teaching mathematics. For Dana teaching mathematics became a process of translating mathematics into a form that her students could comprehend, providing experiences that enable her students to discover relationships and construct meanings, which created opportunities to develop and exercise their mathematical reasoning and problem-solving abilities.

It is evident by the *now* types of instructional math activities Dana uses and by involving her students that this helps them most to construct mathematical understanding and to develop more mature thinking patterns. Teacher certainty and teacher commitment feed on each other, increasing teachers' motivation to do even better. All of

these factors can only enhance student achievement. As a result, the activities Dana now chooses to engage her students in are quite different from the former drill and practice worksheet activities she used before. Dana now finds that changes she has made in her math program are much more fun to teach, but require more planning. The difference for her was in grading one more worksheet that had become boring and she was not happy with what she was doing. As she took the extra measure of work upon herself she began to feel that extra joy and fulfillment teachers come to know as students are engaged and enjoying the learning process. Activities such as games using concrete manipulatives, small group discussions or guided discovery learning help the students in Dana's class discover patterns and relationships. Dana does feel that worksheets now give her information that she is unable to get in other ways. If her students complete worksheets for homework she is able to see what they "grasped" from their playing time in class.

The following questions taken from Michael Fullan's book, The New Meaning of Educational Change, are necessary criteria for assessing change and were answered by Dana in September 2000.

1) Why did you put your efforts into this particular change? This was the subject area that Dana, an elementary teacher, felt the most insecure about teaching. From her first year (1997) she writes of her daily struggles in creating meaningful math activities for her students. Her practices, such as daily worksheets, were not aligned with her beliefs, like real-life problem solving as compared to the other subjects she teaches. She states she was very frustrated.

2) a. Does the change address a need? For Dana the need had become so frustrating to align her teaching practices with her constructivist philosophical beliefs that she was avoiding instructional math activities.

b. What happened next? As she began to network with fellow colleagues she discovered the mathematics curriculum Investigations by Marilyn Burns and decided with skepticism to try it.

c. Did you feel students would learn with this curriculum? Dana had recently gone to a presentation and seen Constance Kamii who endorsed a comprehensive curriculum like Investigations. Kamii told the audience that this type of curriculum promotes learning changes that are seen in smaller increments, but that the excitement shown by the students has proven to promote an increased sense of community among students.

3) Is there evidence that the change worked and produced claimed results? Dana states that a longer time will be needed to decide if these new instructional math strategies worked. She does feel that by fall of 1998 (the 2nd year in her quest) that she was at her “ready point” to fully implement the curriculum used in Investigations. She states she was emotionally and mentally ready at this point and had come to want a change even more after the first year of muddling with Investigations.

4) How clear was it to you in terms of what you had to do to make this change? Dana felt embarrassed by “muddling” the first year (1997 – 1998). She keeps asking herself should this feeling and quest be taking this long to feel comfortable with? That seemed like a very long year with many setbacks. She feels like this experience was very similar to trying to find the correct pieces to a puzzle.

5) How did this change affect you personally in terms of time, energy, new skills, sense of excitement and competence and interference with existing priorities?

Time? – This curriculum takes an enormous amount of time because there is not a textbook for the student.

Energy? – The energy level must be high to continuously monitor the status of the class.

New Skills? – Investigations awards all types of learners and provides activities to relearn previous activities.

Sense of Excitement? – The students smiled a lot and were on task most all the time.

Competence/interference with priorities? – The students exhibited confident in peer tutoring behaviors necessary for enhanced learning.

6) How rewarding has this experience been in terms of interaction with peers and others?

This opportunity afforded Dana excitement she needed at the time in her teaching career for personal growth and sparked her interest in becoming Nationally Board Certified. The National Board Certification was developed by teachers, with teachers and for teachers and is a symbol of professional teaching excellence. Dana chose on a voluntary basis to pursue this venture and in the fall of 1999 was awarded this honor. This distinction has established advanced standards for experienced teachers. Dana had the highest score on her written test in mathematics which was her weakest curriculum subject area before she began her quest in 1997.

7) How did you find balance with all these activities from 1997 to 2000? Dana feels she and her students are continuously experiencing disequilibrium as they are given a

mathematical quests to solve. She states that the students tear apart math problem-solving activities and work together to build them back up in a cohesive manner in order to restore equilibrium. Dana likes the fact that when using Investigations students can not tell who the accelerated learners are because Investigations provides activities that have an equalizing factor which strengthens all students in different ways.

Dana really believes the biggest reason why her mathematical curriculum could not change any faster was because she does not think mathematically. Dana states that it makes her feel inadequate and frustrated when she cannot get a point across clearly and cannot come up with a good activity that helps make it more understandable. She noticed then that a big change she has seen in herself is her acceptance of a higher level of talk and more movement in the classroom setting. She attributes the change to a readiness on her part to have more exploratory learning activities and a relaxed attitude about the effect of noise on the classroom next door.

Keeping the math activities unstructured and relating to real-life mathematics was very hard in the fall of 1997. Time seems to be a problem for Dana. She feels her students need time for playing with concepts. The traditional approach to teaching is now very dull to her. She states she would need extensive training to start seeing life mathematically. For these reasons, Dana has socialized with those teachers around her that have a strong mathematical background. These connections have provided her help in making instructional choices and selecting strategies to use when implementing the Investigations math curriculum. Necessary to this process are how her students embrace the socialization process both in school related activities and during math activities.

Socialization in Dana's classroom still has room for growth, her students are learning to accept responsibility for their parts in transgressions. For the most part, they admit their roles in any wrong doings and are willing to make amends through word and deed. Class meetings have been the catalyst for helping her students face their misbehaviors honestly and responsibly. Because their classroom community is built on trust and respect for one another, they have created a safe climate where no judgment calls are allowed. Therefore, when the students bring up issues about their classmates' unkind attitudes or actions, they are able to discuss their feelings openly and honestly. With resolution as the focus, Dana states the students understand that they will not be blamed nor shamed.

Dana reflects with these words. "My year-long efforts to help my students assume responsibility for their actions through maintaining a strong community and developing their communication skills are starting to pay off. My students are learning they can influence what happens to them by taking control of their own behaviors as well as their responses to their classmates' behaviors. They are also learning that they can take responsibility for their own education through their actions. Her students' developing abilities to assume responsibility for their actions in the academic areas was evident more and more. When they lost Big Word (a spelling program they enjoyed) because they had been irresponsible, her students were eager to devise and implement effective plans to reinstate the program. This activity emphasized for them that privileges come with responsibilities.

Dana writes, "my students entered my classroom developmentally immature in their abilities to consider perspectives other than their own and to take responsibility for their

actions. Therefore, I had to readjust my teaching strategies to meet their needs. First I created tighter external boundaries since they did not respond to an internal locus of control. Then I helped them come to know who they were in a collective sense, to move beyond their egocentrism and instead view themselves as members of a group. I helped them, and continue to help them, grow toward autonomy by giving them many opportunities to consider perspectives other than their own and to be accountable for their actions. Gradually my students are learning to regulate and become responsible for their own behaviors by taking all relevant factors into account, which includes other group members' perspectives."

Educational Implications and Recommendations

A case study cannot be compared to another study because it is about a specific situation with a particular subject which can never again be the same situation. Therefore, it limits the generalizability of the results. This study did, however, provide invaluable insight and information relating to how one makes lasting curriculum changes in the classroom. Educational reform efforts in mathematics can benefit from a study which provides an understanding of the impetus for changes, the stages one moves through as change occurs and finally how successful implementation of changes occur.

Several recommendations can be made regarding steps teachers might want to consider when attempting a curriculum change. I would recommend that the teacher keep a journal throughout the entire change process in order to reflect upon strengths and weaknesses that happen throughout the journey. Research by Fullan (1991) reveals

that active involvement and reflection are required in getting a process underway and moving in a desirable direction.

A second recommendation would be to form a peer support group of teachers who are also wanting to make changes in their curriculum. Dialogue throughout the change process can be very beneficial and empowering. Fullan (1991) finds that when change occurs it is because some pressure has built up that leads to an action. Interactions with peers serve to integrate both pressure and support.

Thirdly, I would recommend that a graduate level course be added to the teacher-education training program. This course on Implementing Classroom Curriculum Changes would need to include how to conduct action based research and provide a network for teachers to communicate with those attempting to conduct research in their classrooms. Research conducted by teachers maintains a close relationship with students in their study. By studying their students, teachers can bring the academic findings down to earth and discover what works in their specific classroom.

A fourth recommendation would be to conduct several case studies to see if there are any patterns associated with making curriculum changes in the classroom. This information could be helpful at the university level in a graduate course on "Implementing Classroom Curriculum Changes" mentioned earlier. Information gathered could provide a data base for teachers to stream-line effective efforts for making changes. It is vital that university professors involved in all aspects of curriculum methods courses work closely with public schools to establish partnerships that lead to change. From these partnerships educational change can be founded in research.

Significant educational change consists of changes in beliefs, teaching style, and materials, which can only come about through a process of personal development in a social context (Fullan, 1991). Teachers must have the personal contact to receive and give help and more simply to converse about the meaning of change. It is vital that teachers have the external support necessary to allow them time for dialogue exchanges to occur so they are in a better position to know whether they should accept, modify or reject the change. Oftentimes, teachers need a chance to try out new programs over an extended period of time to fully know if the change is best for them and their students. If the teacher then becomes an advocate and can become skilled at integrating the change and the change process, he or she can become one of the most powerful forces of change.

It is critical that educators learn to easily identify and understand the underlying process of what constitutes change over time. Research tells us that single-factor theories about change are headed for failure. Therefore, the implications from a study, such as this one go far beyond the classroom to future teachers, parents that home school, professional development schools, Colleges of Education and, of course, teachers. If change is to exist, teachers must be able to have time to reflect and share their experiences as they learn from each other and become change agents. If this study enlightens a fellow educator in such a way that they might choose to reflectively examine their educational practices and attempt changes in lieu of keeping the status quo in their classroom, this inquiry will have found its purpose.

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APPENDIXES

APPENDIX A
IRB APPROVAL

Oklahoma State University
Institutional Review Board

Protocol Expires: 7/30/01

Date : Monday, July 31, 2000

IRB Application No ED0110

Proposal Title: A CASE STUDY: A FIFTH GRADE TEACHER'S COMMITMENT TO FACILITATING
CHANGE IN HER MATHEMATICS CURRICULUM

Principal
Investigator(s) :

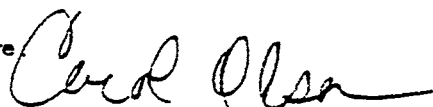
Elizabeth Carver
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Reviewed and
Processed as: Exempt

Approval Status Recommended by Reviewer(s) : Approved

Signature



Carol Olson, Director of University Research Compliance

Monday, July 31, 2000

Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modifications to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

VITA

ELIZABETH COTTLE CARVER

Candidate for the Degree of

Doctor of Education

Thesis: A CASE STUDY: A FIFTH GRADE TEACHER'S COMMITMENT TO FACILITATING CHANGE IN HER MATHEMATICS CURRICULUM

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