1-1-2002

KMEEP : linking theory and practice in an effective science pedagogy.

Elizabeth Flores-Cotte
University of Massachusetts Amherst

KMEEP: LINKING THEORY AND PRACTICE IN AN EFFECTIVE SCIENCE PEDAGOGY

A Dissertation Presented

by

ELIZABETH FLORES-COTTE

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF EDUCATION

September 2002

Education Department

Graduate School of Education

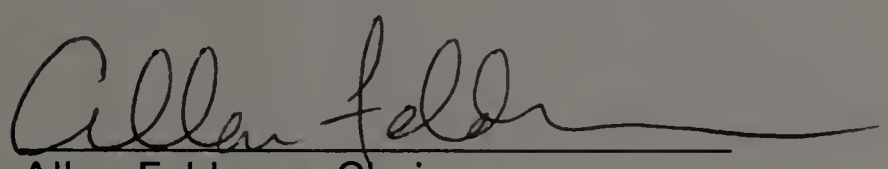
KMEEP: LINKING THEORY AND PRACTICE IN AN EFFECTIVE SCIENCE PEDAGOGY

A Dissertation Presented

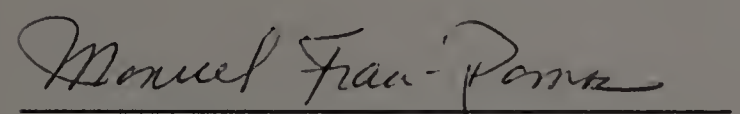
by

ELIZABETH FLORES-COTTE

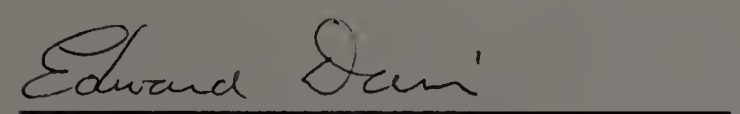
Approved as to style and content by:



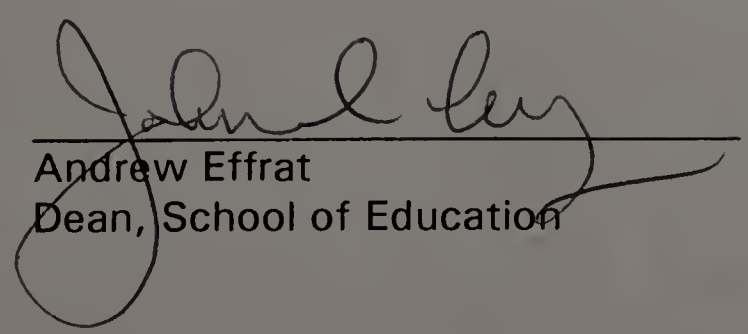
Allan Feldman, Chair



Manuel Frau-Ramos, Member



Edward Davis, Member



Andrew Effrat
Dean, School of Education

DEDICATION

To Jesus Christ my personal Savior who helped me all along this journey and to my parents Antonio Flores Babin and Sara Cotté Garcia who taught me to love God above all things.

ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Allan P. Feldman for his many years of thoughtful, patient guidance and support.

Thanks are also due to Dr. Edward Davis and Dr. Manuel Frau for their contribution to my professional development.

A special thank you to Debbie Tomasi for her tireless effort in typing and editing the many versions of this dissertation.

ABSTRACT

KMEEP: LINKING THEORY AND PRACTICE

IN AN EFFECTIVE SCIENCE PEDAGOGY

SEPTEMBER 2002

ELIZABETH FLORES-COTTE

BSMT, UNIVERSITY OF PUERTO RICO

MPH. UNIVERSITY OF PUERTO RICO

Ed.D., UNIVERSITY OF MASSACHUSETTS AMHERST

Directed by: Dr. Allan Feldman

The purpose of this study was to identify, study and implement the characteristics of effective science pedagogy in the multicultural classroom. The ultimate goal was to identify the instructional strategies in the learning process. The scope of the work included the development of wisdom-in-practice by a skillful teacher. A model (KMEEP) was used for describing the processes of learning and teaching within the multicultural classroom. Case studies were written with the goal of using the classroom experiences of the teacher to bridge the gap between theory and praxis.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

INTRODUCTION TO THE STUDY

This dissertation is embedded in the science education program standards (NSES, 1995) that describe education for quality school programs. They focus on six areas: the consistency of science programs with other standards and across grade levels, the inclusion of all content standards in a variety of curricula that are developmentally appropriate, the coordination of science programs with mathematics education, the provision of appropriate and sufficient resources to all students, the provision of equitable opportunities for all students to learn the standards and the development of communities that encourage, support, and sustain teachers.

This dissertation presupposed the examination of my practice on a daily basis, using my classroom experiences for the development of wisdom-in-practice. Using reflective methodologies, I identified the main components of the teaching-learning processes. As a science educator, I stressed inquiry and critical thinking examining the realm of classroom experiences in study, investigation, observation, and experiencing facts and ideas.

The road toward acquiring wisdom-in-practice is described in this dissertation starting with the identification of the learning theories associated with teaching and learning science within a multicultural environment. It includes the revision of the principal terminology associated with the process of learning science. The study serves to describe the use

of the KMEEP model in multicultural science education, demonstrating the interconnection between praxis and theory during the teaching-learning process. This interconnection demonstrates the link between the classroom and the teaching-learning processes.

The final outcome of this study is a written document that describes my development of wisdom-in-practice becoming a curricular designer and negotiator using action research as I search for excellence teaching science in the multicultural classroom.

Science pedagogy is primarily based on the recognition of the concomitant factors of education and the preservation of the students' rights for individuality. This study is centered on the following research questions:

a) How do I develop wisdom-in-practice and become a curricular designer and negotiator using action research?

b) How do I use wisdom-in practice to teach in the multicultural science classroom?

Effective science pedagogy is important for nations, individuals and overall democracy. For nations, education means more opportunities in which the citizens contribute more personal income. For individuals, an educated workforce means a more competitive and productive society with a higher standard of living. For overall democracy, it means citizens processing the knowledge and skills necessary to deal effectively with the complexity of today's problems.

According to the report of the National Commission on Teaching and America's Future (Minneapolis University Press, 1996), the most important strategy for achieving America's educational goals is recruiting, preparing and supporting excellent teachers in all schools. There are approximately 70,000 middle school science teachers, 116,000 science teachers in grades 9-12, and 1.9 million elementary teachers (State Indicators of Science and Math, 1997; Digest of Educational Statistics, 1997). Only 63 percent of high school and 17 percent of middle school science teachers have a degree in science.

In comparison, activities reported by high school teachers were 42 percent lecture or whole class discussion time, and 21 percent hands-on activities or laboratory work (State Indicators of Science and Math, 1997). The need for effective science education paradigms is evident when the projected school enrollment, both public and private as of March 1998, for the grades K-12 in public schools is 5,863,000 (American Education Statistics At A Glance, March 1998). Both the full-time private and public school teachers reported working an extra 12 to 13 hours before and after school and on weekends. About one-fourth of the time was spent doing activities involving students (Condition of Education, 1998).

Our national educational goals called for a high school completion rate of 90 percent for the year 2000. Currently about 80 percent of our students are earning diplomas or their equivalent by age 24 (National Center for Education Statistics, 1995). The goal has not been met even in 2002.

This study took place within a school of 1,400 students where 47 percent are Hispanics (mostly Puerto Rican), 31 percent are blacks (mostly African American), 18 percent are white, and 3 percent are Asian. The scope of this study involved adding to the knowledge based on teaching and learning through a series of interrelated activities which included case studies of my own teaching experiences. The vivid experiences of multicultural students as they learn science in public schools provide for a perfect model of the learning process.

The identification of the multiple perspectives of effective science pedagogy provides for the use of a model that places together the diverse features of multicultural science education. The study used ethnographies, case studies that express the diverse components associated with effective science pedagogy.

This dissertation study focused on the identification of ways to link theory with practice in an effective science pedagogy. The process was twofold. First, addressing the students' points of view identifying how I became a wise practitioner, using reflective techniques as I developed and negotiated curriculum. The process was ethnographic in nature, where the reality of the classroom came alive to the reader, through the eyes of the participants, teacher and students.

The direct insight into the classroom dynamics are presented to serve the purpose of answering the question: "What is going on here?" The dissertation study describes my development as a teacher, as I became a

wise practitioner linking theory with practice. The reflective approach serves the purpose of identifying connections between my work and the students' world. A sound theoretical framework provided for the construction of a bridge that reflects theory within the practice as I negotiated curriculum change for the betterment of my practice.

The answer to the question, "What is going on here?" would be lost if student/teacher interactions and processes were not made evident using action research techniques. Action research provides the means of evaluating each individual practice searching for answers. I developed tools for effective practice through a dynamic process of interaction with the students in the classroom environment. This dissertation provides evidence that classroom practice provides information about constraints for the learning processes and effective strategies that can be used in the cognitive process to enhance learning and develop wisdom-in-practice. As the teacher in the development of a model that interconnects the diverse components of the learning process, I used practice interacting with a sound theoretical background.

This dissertation also presents results in terms of objectives, and analysis used in evaluating a system that might be made to work better. This identification of essential features and systematic description of interrelationships among them is, in short, "How do things work?" The final term in this qualitative inquiry is interpretation, which addresses procedural questions of meanings and contexts. The final insight will be provided by

the answers to questions such as, "What does it all mean?" and "What is to be made of it all?"

The sequence of this dissertation study follows the descriptive-analysis-interpretation approach. It contains the relationship of this dissertation to the development of educational thinking.

The second chapter identifies the theoretical framework that sustains and nourishes a living dynamic learning process. The literature review provides abundant theoretical background that was used in my journey trying to reach wisdom-in-practice. The third chapter presents the methodology used in this dissertation. The fourth chapter presents the data analysis and results of this study. The chapter includes analysis of excerpts using the phenomenological and reflective approaches. This analysis is used to describe the interactions between theory and practice in my classroom. In this chapter I describe my development as a teacher as I gain wisdom-in-practice.

I conclude this dissertation with Chapter Five, Conclusions and Implications of the Study. In this chapter I return to my research questions summarizing the results in a description of a new model that integrates theory with practice. I presented implications and recommendations for further research in science education.

According to Wolcott (1991), a researcher who lacks a clear sense of purpose — the ability to set up a problem — cannot narrow the research focus sufficiently to achieve any purpose at all. The sense of purpose of

this dissertation is clear from the very beginning: linking theory with practice in an effective science pedagogy. As a researcher I succeeded in my effort, establishing a sound theoretical framework as I discovered the concomitant factors of learning and teaching. The whole process vividly occurs in the multicultural science classroom and is perpetuated using action research, providing for the reflection on the significant moments in my practice. I accomplished my goals as I unveiled the mystery of education.

Albert Einstein (1948) once said that,

> The most beautiful thing we can experience is the mysterious. It is the source of all-true art and science. He to whom this emotion is a stranger, who can no longer pause to wonder and stand rapt in awe, is as good as dead: his eyes are closed. (p. 108)

As a researcher, I invite the reader to my classroom. I encourage them to experience the mysteriousness of multicultural environment with open eyes. As a teacher, I opened a window to the practice that made me a wise practitioner, as I developed innovative strategies both for teaching and learning. My only advice to the reader is to remember that a mystery will be revealed to their eyes that describes the importance of linking classroom practice to theoretical frameworks.

It is very important that I give the reader a vision of hope. The mystery itself is around the ability to see that a bridge is being built. Every single brick in the cognitive process links theory with practice producing an effective pedagogy. The spark of hope comes from classrooms as teachers write the significant incidents that characterize the dynamics of interaction

between teachers and students, administrators and parents, and every single component of the educational process.

Using Action Research in an Effective Science Pedagogy

As I researched my practice, I found the commitment to research itself and the development of a body of professional knowledge. As an action researcher, I expected to enhance not only the efficiency and responsiveness of my practice but also my status as an educational practitioner. Effective teachers employ a range of personal skills in developing and using knowledge (1998). They arrive at a singular wisdom derived from practice. They discover the pathways that are required to become sophisticated both in curriculum design and curriculum negotiation. They establish the support mechanisms to ensure coherent progression in the development of knowledge and skills. That way, called by action researchers "reflection upon action," guarantees success in practice. Using action research in my practice, I have had the opportunity to:

1) Reflect upon and record the ways in which my personal teaching style developed.
2) Create a record of knowledge, skills and teaching strategies gained from practice.
3) Reflect upon recorded knowledge, which includes unanticipated teaching outcomes.
4) Receive clear feedback on my practice performance.

5) Discuss teaching strategies and future needs with other educational practitioners.

6) Receive support in gathering and organizing portfolios of evidence of major achievements from my practice.

7) Use practice experiences to enhance future planning.

This descriptive study serves for the identification of students' deficiencies, together with the teaching strategies needed for enhancing the learning of science within a multicultural environment. The constructivist pedagogical techniques are identified and used in designing and developing a model based in the uniqueness of the classroom. The utilization of the classroom experiences give the teacher a voice in the issues related to science education.

Teachers engaging in action research will have a positive effect on the future of teaching in general by changing the perception that people have about the teacher's role (Feldman, 1995). According to Feldman, by participating in the action research process, teachers begin to see themselves and can be seen by others as more than implementers of policy, curriculum, and pedagogy devised by those who are usually considered authorities. Instead, teachers are recognized as the experts that they are in domains of their own experience. It is possible that such activity by teachers will lead to a redefinition of teaching that recognizes that teachers have the capability of taking the lead in obtaining the insights necessary to improve their own practice.

Basic Components of the Multicultural Learning Process

Introduction

The learning process for the multicultural student is a product of interaction with the environment. I reached this conclusion as I conducted a pilot study (Flores-Cotte, 1998) prior to this dissertation study. I discovered that in order to produce significant changes in the learning process of marginal students the following components must be integrated in a single and collective approach to learning:

A. Self-esteem component

   Purpose: develop security, identify, and sense of belonging, purpose and competence.

B. Moral-ethical component

   Purpose: develop the students' abilities to decide between conflictive valorative situations.

C. Social component

   Purpose: develop the social interactions needed for survival in an interconnected climate.

D. Historic-epistemologic component

   Purpose: develop the core foundation for students' construction of knowledge and arrival at performance.

Description of Research Model (KMEEP)

The classroom requires a skillful teacher and a learner dealing with a core of knowledge that is meaningful. The following steps presuppose a

process that will be directly identified from the classroom interactions. The teacher-student relationship should be established based on confidence and trust. The KMEEP model (knowledge - memory - experience - evaluation - performance) provides for classroom interactions. The model establishes the necessary steps for the learning process to occur. It includes four major components that surround the learning environment. These components are self-esteem (Component A), moral-ethical (Component B), social (Component C), and historic-epistemological (Component D). The self-esteem component becomes evident as the learning process is developed in the multicultural science classroom. The self-esteem component is identified throughout a series of observations and interviews using the phenomenological approach (Seidman, 1991). Additional information is derived from the administration of a questionnaire using the classification of each student's level of self-esteem. The moral-ethical component is clearly identified using Kohlberg's (1981) classification instrument. The last two components emerge after careful evaluation of the data. The third component, social, is associated with individual learning styles using observations and interviews (Myers & Briggs, 1979; Oakland & Horton, 1998). The last component, moral-epistemological, provides for the core foundation of knowledge leading to performance.

The classroom provided the framework to examine the cognitive domain of individual students in their unique search for knowledge, cumulative learning, and integration, relations and connections essential to

learning. Finally, the science classroom serves for the codification of the major components of a process that is continuous as well as very diversified and unique.

The KMEEP Model also provided for identifying the reflections upon the actions of a skillful teacher. The Reflective Approach to Pedagogy was based upon the work of Schön (1987) and Feldman (1993). The final outcome of the study is the model KMEEP which describes the teacher's arrival to wisdom-in-practice.

Research Model

Model (KMEEP) Flow

KNOWLEDGE

EVALUATION

Multiplicity of Options

MEMORY Social Interaction (Modifiers)

PERFORMANCE

(Long-term Memory) I

(Short-term Memory) II

EXPERIENCE

Definitions:

A. KNOWLEDGE. Applies to facts or ideas acquired by study, investigation, observation or experience.

B. MEMORY. The power or process of reproducing or recalling what has been learned and retained through associative mechanism.

C. EXPERIENCE. Fact or state of having been affected by or gained knowledge through direct observation or participation.

D. EVALUATION. To determine the significance, worth or condition of by careful appraisal and study.

E. PERFORMANCE. Ability to execute or accomplish an action.

KNOWLEDGE > MEMORY > EXPERIENCE > EVALUATION > PERFORMANCE

Interactions

The Learning Process

(Component A)
Self-esteem

(Component B)
Moral-ethical

KNOWLEDGE
MEMORY
EXPERIENCE
EVALUATION
PERFORMANCE

(Component C)
Social

(Component D)
Historic-epistemological

Research Objectives

General Objectives:

1. Identify the learning theories associated with learning science within a multicultural environment.
2. Explain the principal terminology associated with the process of learning science.
3. Describe the KMEEP model designed for multicultural science education.
4. Describe the interrelation between the praxis and theory during the learning process.
5. Demonstrate the interconnecting links between the classroom and the learning processes.

Specific Objectives:

1. Identify the learning process components within a sample of multicultural science students.
2. Explain the principal terminology associated with the learning science process.
3. Identify the instruments and technology associated with learning science.
4. Discuss the interaction of the diverse components of the KMEEP model for science educational assessment.
5. Compare the different learning theories and strategies.
6. Explain the learning process used in multicultural science classrooms.
7. Apply the principles of the KMEEP model to curricular design in science.
8. Assess the relevance of learning theories in resolving problems associated with the learning of science.
9. Provide examples from the praxis in accordance with diverse learning theories.
10. Design a model that integrates praxis and theory in science learning to be used in multicultural classrooms.

CHAPTER 2

REVIEW OF THE LITERATURE

Theoretical Framework

In this dissertation I review the research literature on constructivism, multiculturalism and reflective science pedagogy.

Constructivism

In order to understand constructivism it is necessary to clearly identify what it means. According to Feldman (1994) in science education the meaning of constructivism corresponds with three different domains: epistemology, pedagogy, and learning theory.

The word epistemology comes from the Greek word epistemé meaning knowledge, and the Greek word epistendi meaning to understand. In other words, epistemology is the study of nature and grounds of knowledge with reference to its limits and validity.

This dissertation study addresses the acquisition of knowledge of myself as the teacher. The study describes the development of wisdom-in-practice, using my learning process as a reference. According to Feldman (1994), epistemologically, constructivism is a way of understanding what we mean by knowledge, science and doing science. Its current usage derives from work in the philosophy and sociology of science by Kuhn (1970) and Lakatos (1978), among others and can be traced back to classical and renaissance authors (Von Glaserfeld, 1995).

This dissertation study centers on the art and science of the profession of teaching called pedagogy. I recollected the knowledge and development resulting from the educational process of myself as a science educator. This process is described in the collection of my experiences as a practitioner in the science education field.

The third domain in science education is the development of a learning theory. In this domain, I describe my own process of gaining knowledge and understanding in the science education field. A learning theory encompasses the act or experience of the one that learns. It also includes the modification of behavioral tendencies by the experience.

In this dissertation study behavior is defined as the manner of conducting oneself in the practice. It is necessary to clarify that this dissertation study is not experimental in orientation, emphasizing the application of the principles of teaching to certain stimulation.

Constructivism is used in this study as a label for sets of teaching techniques or models for lessons (e.g.; Fensham, 1989; Brooks & Brooks, 1993). Finally, constructivism is identified as a learning theory (e.g.; Mathews, 1992; Coburn, 1993). In this domain, knowledge is what people learn, and learning is described as the construction of knowledge.

Constructivism theory is built upon two principles: first, learning is not passive; understanding cannot be directly placed in the student's mind. Second, we only know the world through our experiences and we use these

experiences to make sense of our reality (Whately, 1991; Von Glaserfeld, 1987).

Students also have specific perceptions of science. The theories students construct from their personal view of the world, allow them to look for the principles that govern their experiences and make sense of new data (Driver, 1994; Smith, 1994; Ausubel, 1968). Their construction is based on beliefs, past experiences and current attitudes; it is the foundation for learning and colors all actions. If the theory breaks down, it is changed to accommodate conflicting data and produces a modified construct (Zais, 1976; Ausubel, 1963).

Theorists in the past few years, together with researchers, teachers and other social scientists have become increasingly interested in the learning cycle as a model of instruction and procedure for curriculum development. Scherman's (1992) descriptive study provides a rationale for the use of the learning cycle as an alternative instructional strategy for assessing misconceptions and promoting conceptual change. Marek and Methuen (1991) examined the relationship of teachers' attitudes and the implementation of workshop-developed learning cycle in their science classroom. The learning cycle is not a new concept in science education. It has origins stemming from the 1960s, and has been referred to as an alternative exploration-invention-discovery (Karplus & Thair, 1967), exploration-concept introduction-concept application (Karplus et al., 1967),

exploration-conceptual invention-conceptual expansion of idea (Renner, Abraham & Birnie, 1985), exploration-conceptual invention-conceptual expansion (Abraham & Renner, 1986) and exploration-term introduction concept application (Lawson, 1988).

Contemporary writers describe the phrases of the learning cycle essential to the development of concepts in terms of the Piagetian theory: the exploration phase parallels the ideas of assimilation and unbalance, the conceptual invention stage is analogous to the principle of accommodation, and the conceptual expansion phase facilitates organization (Renner & Mark, 1988). Glasson and Laliks (1990) study the learning cycle from a language-learning perspective focusing on the "unique." The authors found that when teachers framed their instruction with the learning cycle they focused on aspects that were consistent with their preexisting beliefs.

Repeatedly, the answer to the question, "How do people acquire knowledge?" leads back to the early studies of the Swiss psychologist Jean Piaget. Piaget began his professional studies as a biologist. His psychological theory of knowledge acquisition was inspired by biological theories, particularly embryo development and evolution.

The rationale for this section is based on teachers' need to grasp the meaning of Piaget's theoretical concepts. The main purpose of this section is the interrelation of my theories with the practice that support the teaching-learning processes.

Paiget's Concept of Knowledge

According to Piaget, all knowledge is a construction resulting from the child's action. Piaget considered the existence of three kinds of knowledge: physical knowledge, logical-mathematical knowledge, and social-arbitrary knowledge. Each requires the child's actions, but for different reasons.

Physical Knowledge: Discovery. It is the knowledge of the physical properties of objects and events: size, shape, color, weight, and so forth. A child acquires physical knowledge about an object while manipulating it (acting on the object), with his or her senses. In the acquisition of physical knowledge, the "objects" tell the child what they can or cannot do. Feedback or reinforcement is provided by objects themselves.

Logical-Mathematical: Invention. It is the knowledge derived from thinking about experiences with objects and events. In the development of logical-mathematical knowledge, the nature of the objects is not central; only that there are groups of objects for the child to manipulate. Like physical knowledge, logical-mathematical knowledge is not acquired from reading or listening to people talk. It is constructed from objects and action on them.

Social: Arbitrary Knowledge. It is knowledge developed by mankind. It includes knowledge of rules, laws, morals, values, ethics and language systems. This knowledge evolves within cultures. Social arbitrary knowledge is constructed by children from their interactions with other

people. In other words, arbitrary knowledge depends on intellectual discretion, and it is fixed by laws, not restrained or limited in the exercise. It is determined by individual preference or convenience.

Piaget's theoretical framework provided for a developmental theory of knowledge. Each individual constructs knowledge as he passes through different stages. This process can be compared with the embryo developmental process. A person's learning cycle is embedded in different stages until it reaches full maturity, similar to an embryo development as a living organism. The stages of cognitive development are clearly identified by Piaget's writings as follows:

<u>Stages of Cognitive Development</u>

I. Stages of sensory-motor intelligence (0-2 years)

During this stage behavior is primarily motor. The child does not yet internally represent events and "think" conceptually.

II. Stages of pre-operational thought (2-7 years)

The development of language and other forms of representation and rapid conceptual development characterize this stage. Reasoning during this stage is logical or semi-logical. In the early part of the pre-operational stage, language ability is formed and organized. The language behavior of a three-year-old child typically lacks the organizational stability of a seven-year-old, though they will demonstrate the characteristic of the pre-operational stage.

III. Stage of concrete operations (7-11 years)

During these years, the child develops the ability to apply thought to concrete problems. A child at age seven on average can build a straight fence consistently in a line in any direction across the table, and he or she will check the straightness of the line by shutting one eye and righting it as a gardener lines up bean poles. It takes considerable development for children when they come between the ages of nine or ten to develop the ability to distinguish and coordinate different possible perspectives. At the same time the child formats the concept of projective space. He or she also constructs Euclidean space, and these two kinds of constructions are based upon one another.

IV. Stage of formal operations (11-15 years)

During this stage, the child's cognitive structures reach the greatest level of development, and the child becomes able to apply reasoning to all classes of problems.

Factors that Influence Development

Piaget suggested four broad factors that are related to all cognitive development. The learning process does not occur without the influence of four broad factors: discovery (physical knowledge), invention (logical mathematical), arbitrary knowledge (social), critical thinking (development).

These factors are vital for science education and are considered in this dissertation study.

The first factor, discovery (physical knowledge), is related to children's and teacher's ownership of environment, intentional thought about materials and how they are related to learning with logic and coherence about materials and environment. According to the National Science Education Standards (NSES) (1995) teachers of science should design and manage learning environments that provide students with time, space and resources needed for teaching science.

The second factor, arbitrary knowledge (social) refers to layers of content knowledge that allows different levels of engagement and interaction. NSES standards encourages that teachers of science plan an inquiry-based science program for their students. They advised teachers to develop a framework of year long and short-term goals for students, selecting science content, adapting and designing curricula to meet the interests, knowledge, understanding, abilities, and experiences of students.

The third factor, invention (logical-mathematical), encourages and models skills of scientific inquiry as well as curiosity, openness to new ideas and data, and skepticism that characterize science. NSES encourages that teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.

The fourth factor, critical thinking (development) is fundamental for science education. Steinberg and Spear (1996) in their article Teaching for Thinking describe ideas about promoting thinking in K-12 classrooms which teachers can implement in teaching. Steinberg's triarchic (three part) theory of thinking classifies thinking in three basic kinds: analytical, creative, and practical. According to Steinberg's theory, analytical thinking involves analyzing, judging, evaluating, comparing, contrasting and examining. Creative thinking includes creating, discovering, predicting, imagining and supposing. Practical thinking involves practicing, using, applying, and implementing.

Steinberg and Spear (1996) consider that there is no more important goal in education than "... to teach students to think well" (p. 457). For then there are seven skills which are not exhaustive or mutually exclusive:

1) recognizing and defining the existence of a problem
2) process selection
3) representation of information
4) strategy formulation
5) allocation of resources
6) solution monitoring
7) evaluating outcomes

Spear-Sterling (1996) indicates that there needs to be a balance among these different types of thinking and that students need to "... learn that

kind of thinking is expected of a person in different kinds of situations, and then to try to do the kind of thinking that is appropriate for the given situation" (p. 457). Further, analytical thinking and critical thinking are the same (p. 140); analytical thinking is defined as "thinking that dissects, critiques, evaluates, and judges" (p. 151).

The standards for science teaching are grounded in the assumptions that students' learning is greatly influenced by how they are taught and that students' understanding are actively constructed through individual and social processes. The standards are also grounded upon the assumption that the actions of teachers are deeply influenced by their perception of science as an enterprise to be taught and learned.

NSES (1995) encourages teachers of science to understand and facilitate learning focusing and supporting inquiries while interacting with students, orchestrate discourse among students about scientific ideas, structures and facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse. The academy also encourages teachers to develop models and emphasize the skills, attitudes and values of scientific inquiry.

Olsen (1999) in his writing Constructivist principles of learning and teaching methods, emphasizes that constructivist learning and teaching involves focusing on the quality of students' intellectual work by promoting student higher order thinking.

Constructivist learning and teaching requires minimizing the structure of student learning activities in order to recognize the student freedom in learning. To obtain their goal, the teacher must develop a deep knowledge of pedagogy to help students identify learning strategies to reach learning goals.

Piagetian Terms and Definitions

These definitions are based in Piaget's writings. He published five books between 1923-1932 that are considered the first period of his theory. There are references to structures, equilibrium, importance of action, and to an assimilation process. The second period of his theories represents the books written in the 1930s (Paiget, 1936, 1937, 1946). During this period he stressed the functional aspect of knowledge: to know something means to incorporate it into action schemes (Piaget, 1952, p. 41-48). Piaget published books increasingly for about 60 years and wrote over 20,000 pages.

Maturity and Heredity. Piaget believes that heredity plays a role in cognitive development though heredity alone cannot account for intellectual development at any point and time. Maturation unfolding from inherited potential is the mechanism by which these limits are established.

Active Experience. It is one of the four factors in cognitive development. Each kind of knowledge a child constructs (physical, logical-

mathematical, social arbitrary) requires him or her to interact with objects or people.

Social Interaction. By social interaction Piaget meant the exchanging of ideas among people, peers, parents, and other adults.

Assimilation. It is the cognitive process by which a person integrates new perceptual, motor, or conceptual matter into existing schemata or patterns of behavior. Assimilation theoretically does not result in a change of schemata, but it does affect the growth of the schemata and it is thus a part of development. During assimilation, a person imposes his or her available structure on the stimuli being processed. That is the stimuli are forced to fit the person's structure. Assimilation at this moment accounts for growth.

Equilibration. It is a state of balance between assimilation and accommodation. It is the process of moving from disequilibrium (a state of imbalance between assimilation and accommodation) to equilibrium. This is a self-regulatory process whose tools are assimilation and accommodation. Equilibrium allows external experience to incorporated into internal structures (schemata). Equilibrium is a necessary condition toward which the organism constantly strives. The person ultimately assimilates old stimuli (or stimulus events) with or without accommodation. This results in equilibrium. The equilibrium can be as vivid as a state of cognitive "balance" that is seeded at the point of assimilation.

Schema-Schemata. Cognitive or mental structures by which the individual intellectually adapts and organizes the environment. As structures, schemata are mental counterparts of biological means of adaptation, can be simplistically thought of as concepts of categories. Schemata never stops changing or becoming more refined. Schemata are intellectual structures that organize events as they are perceived by the organism into groups according to common characteristics. Schemata are defined by (or reflected in) the overt behavior of the child. But, schemata are more than behavior, they are the internal structures from which the behavior flows. Every schema is coordinated with all other schemata, and itself constitutes a totality with differentiated parts (Piaget, 1952).

Accommodation. It is the creation of a new schemata or the modification of the old schemata. Both actions result on a change in or development of cognitive structures (schemata). In accommodation, the person is forced to change his or her schema to fit the new stimuli, therefore, accommodation accounts for development.

The Constructivist Framework from Piaget to Neo-Piagetian

According to Piaget (1964),

> The principal goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done — men who are creative, inventive and discoverers. The second goal of education is to form minds which can be critical, can verify and not accept everything that they are offered. (p. 176)

Piaget (1964) established that learning in the specific sense cannot explain development, instead, development explains learning. The cognitive development consists of a succession of altering equilibria and disequilibria to reconcile both the stability and the changes that occur in cognitive development and to emphasize the dynamic aspects of this process. Piaget calls it optimizing equilibration. Piaget summarizes the process as follows: "The goal of intellectual education is not how to repeat or retain ready-made truths. It is learning to master the truth by oneself at the risk of losing a lot of time and going through all the roundabout ways that are inherent in real activity" (p. 256).

According to neo-Piagetians (Mayer, 1985; Nevell & Simon, 1972; Ross, 1980; Holland, 1986), knowledge refers to a socially accepted linguistic and symbolic focus located in the world. This distinction reflects a psychological constructivistic position in that the meaning appears to be exclusively in the head. Different versions of constructivism characterizes the relation between the individual and social realms.

Piaget, according to his critics, has a serious theoretical weakness. The psychological research on problem-solving (e.g.; Mayer, 1985; Nevell & Ross, 1980; J. H. Holland et al., 1986) summarize large numbers of studies suggesting that adults are prone to making inferential errors in many situations due to the combination of certain types of information-processing strategies (i.e., the availability and representative heuristics, the vividness

criterion) and the specific knowledge structure evoked by the situation. Individually, similarly to scientists' attempts to access covariation between events, assign causality, predict future events, and build their own theories about the phenomena of interest (Nisbett & Ross, 1980). Of course this does not mean that individuals follow normative principles of statistical reasoning or hypothetical-deductive thinking as suggested by Piaget (Holland et al., 1986). Considerable progress has been made during the past 20 years in the related fields of neural psychology and neural modeling.

In 1990, Luria Alexander developed the Pass Model whereby the brain is divided in three functional units. The first functional unit is associated with the upper brain stem and the limbic system. This unit is conceived with the vigilance or attention and the discrimination among stimuli. This part is critical to cognitive processing because it provides a general state of readiness and a focus of attention. The second functional unit is associated with the posterior region of the cerebral hemispheres, including the visual (occipital), auditory (temporal), and general sensory (parietal) areas. This unit is concerned with the reception, elaboration, and storage of information by means of simultaneous and successive processing. The third functional unit is associated with the anterior region of the cerebral hemispheres, particularly the prefrontal region. This region is responsible for the programming, regulation and verification of cognitive activity. This unit regulates the activities of the first functional unit so behavior will be

consistent with the individual's conscious goals and motives. Summarizing, the first unit is responsible for arousal and attention, the second unit is related with reception, analysis, and storage using simultaneous successive reasoning process, and the third unit is responsible for planning, regulating and verifying mental activity. These new discoveries of brain knowledge acquisition serve to establish a relationship with Piaget's theory of learning.

No matter the latest findings, Jean Piaget is famous for having traced the broad stages in the development of intelligence of children in his studies from the thirties to the seventies. Transition from stage to stage is by conflict and disequilibrium followed by equilibration, as the child both assimilates the environment and adapts it to himself. Piaget also believed that moral conceptions went through such sequences. Other researchers have taken much further developing the theory of moral judgment (Kohlberg, 1985). Lawrence Kohlberg has likened the six stages of moral development to an ascent from the shadows of Plato's allegorical cave to the sunlight of "True Justice" (Sockett, 1992). These stages are:

Level I - Obedience-punished oriented

Level II - Egotistic oriented

Level III - Post conventional

Level IV - Values interaction

Level V - Ownership of values

Level VI - Performance according to values

This theory involves the interaction of the organism and the environment, it is not a purely biological sequence nor does it estimate an individual's worth apart from social opportunities. It is less concerned with learned content which can be forgotten than with evolving moral values which are not. Moral development, it seems, tends to correlate with Piaget's intellectual stages, especially the transition from concrete to formal operations, as does high IQ, college education, privileged social opportunities, youthfulness and the affluence of a culture.

According to Sockett (1992) the range of issues on which Kohlberg's views of moral development have been criticized is formidable, three of which may be noted here. First, there have been concerns about the status of stage six. Its central importance for Kohlberg is that "a terminal stage, with the principle of justice as its organizing principle, helps us to define the area of human activity under study." Gibbs (1977) argues that stages five and six are not structural as Piaget would understand it, but refer to metaethical matters. Gilligan and Murphy (1983) deny the existence of a developmental path from stage five to stage six. Second, Kohlberg also insisted on the separation of the force or structure within which people make moral judgments from the content of those judgments. Critics such as Hamm and Peters (1977) argued that Kohlberg was either struggling on content to his theory of moral development or that he failed to recognize, particularly in the early socialization of the child, the need for basic rules of

content without which socialization could not be maintained. Third, Kohlberg's development toward school-based work left on one side various unanswered philosophical complaints. Critics have fastened particularly on the absence of an explicit relationship between moral judgment and moral action. Kohlberg (1985) admitted that the development of justice reasoning stages through moral dilemma discussion was insufficient to affect moral actions. The just moral community aimed "to change action by changing the moral atmosphere of the school" (p. 61). On the other hand, Carol Gilligan's (1983) research in cognitive development has provided for many of today's scholars to explore and revise leadership as we know it. She has developed her contribution of women's thinking to pedagogical theory in education. Gilligan (1983) argues that a single model of reasoning patterns and stereotypes of moral development fails to capture the different realities of women's issues.

In search of an answer to the question, "How do people acquire knowledge?" we discovered a variety of ideas of what intelligence is. Theorists such as Thorndike (1898) ascribe intelligence as the capability for making connections. Spearman (1904) writes about it as the general ability to produce relationships. Thurstone (1938) accounted intelligence as a relative small number of primary mental abilities. Gilford (1967) identified six types of mental operations, content and products. Sternberg (1988) developed a theory of intelligence expressed in three forms: componential,

experimental, and contextual. At the very end of the theoretical search for the learning process we find intelligence associated with the upper part of the brain and limbic system concerned with the vigilance or attention and the discrimination among stimuli. We arrived to the basic unit of the functioning nervous system and the nerve cell or neuron.

Learning, according to Grossberg's (1983) theory, occurs when synaptic strengths increase and make the transmitter release rate increase. The transmission signals from one neuron to the next easier. Hence, learning is in effect an increase in the number of connections among neurons "operative" until the transmitter release rates at a certain terminal knob increases above a specified threshold. The key point in terms of neural modeling theory is that learning is driven by simultaneous activity are pre and post synaptic neurons.

The process of equilibration as described by Piaget and as previously explained at the level of neural models clearly implies that knowledge acquisition is a process in which the learner actively constructs his or her knowledge. Such views have become known as constructivism (Piaget, 1977a, 1977b; Resnick & Wittrock, 1974). Constructivism stands in marked opposition to the empiricist doctrine that complex knowledge is assimilated directly from the environment. It also stands in opposition to the nativism doctrine which assumes the existence of innate structures that

unfold spontaneously with maturation (Chomsky, Fodor & Piatelli-Palerini, 1980).

According to Bereiter (1985), however, a fundamental theoretical problem exists with constructivism. As Bereiter sees it, constructivist theory offers no satisfactory amount of how the learner, if guided only by simple cognitive structures, can generate more complex structures, which allow new behaviors with distinctive properties. Bereiter asks, "How can a structure generate another structure more complex that itself?" (p. 204).

The learning paradox problem has been tested against a solution proposed by Lawson and Stover (1989) based on the concept of emergent properties and in part on the neural modeling principals. It is still unresolved, but brought us to realize that Piaget was right in his claim that children's reasoning begins with the concrete whereas the adult reasoning can begin with hypothetical.

The Multicultural Science Classroom

The term multicultural education was introduced in the 1960s and has been defined by a variety of researchers in fields other than science education. Banks and Banks (1989) defined multicultural education as an idea, and educational reform movement, and a process whose major goal is to change the structure of educational institutions so that male and female, exceptional students, and students who are members of diverse ethic and cultural groups will have an equal chance to achieve academically in school.

The National Science Teachers Association (NSTA, 1983) has developed a position statement on multicultural science education. It has defined as one of its goals to ensure that "culturally diverse children ... have access to quality science education experiences that enhance success and provide the knowledge and opportunities required for them to become successful participants in our democratic society" (NSTA, 1992, p. 159).

Smith (1989) has called for a new direction in multicultural education for teachers. He proposed a new direction "researched based," whereby the central core of multicultural education becomes knowledge of minority achievement and learning, the parameters of which have never been identified and the content of which has not been placed in a broad theoretical framework that can be taught effectively in teachers' education programs.

The multicultural classroom provides for a model of instruction that has long been accepted as effective methods in schools of law, medicine, political science, teachers' education, journalism and others. Self-regulation approach using case-based has been defined as the motivation to implement, monitor, and evaluate various learning strategies for the purpose of facilitating knowledge growth (Ertimer, 1995). Basic research and theory in student use of self-regulated learning concluded that self-regulated learning theories have great potential for guiding students to become more self-reliant and effective learners (Zimmerman & Barry, 1986; Educational Psychology

Review, 1990, pp. 173-201). The literary review on learning to learn suggested that general learning techniques of learning should be learned in a relative late phase of human development and education (Klauer, 1988). Further learning theories try with, in addition to, in opposition to, or without regard for biological or sociological stimulation (Richlak, 1988).

The multicultural science classroom provides the arena that teachers can use to design strategies that are tailor-made for diverse students. It is within the multicultural science classroom that teachers demonstrate in their commitment to enhance learning in direct interaction with their learners. Studies of the wide field of research have demonstrated that students' own ideas about phenomena that they encounter in science classrooms are rarely addressed, students do not use science concepts systematically, and meaningful change in students' beliefs about science phenomena does not occur (Anderson & Smith, 1984; Rice & Feher, 1987; Stead & Osborne, 1980).

According to researchers, classroom experiences should be organized to allow students to articulate their personal constructions and negotiate the meaning to their constructs (Fetherstone, 1997). Driver and Bell (1985) summarized seven propositions relevant to classroom learning that include the following:

1. The direction of learning is determined to be the learner's existing constructs.

2. Learning, questioning, and exploration occurs continuously and actively.
3. Events can be interpreted in a large number of equally valid and possible ways.
4. Learning involves the elaboration of a construct system.
5. Learning involves change in a person's construct system.
6. Constructing is a refining process leading to abstraction and generalization.
7. Learning in science involves constructing the construction process of scientists, teachers, and students.

An alternative ideology for science teaching recognizes that science is embedded in, and influenced by, society and culture. The influence occurs mainly because scientific knowledge is socially constructed, in the sense described by academics in the field, known as the social studies of science (Barnes & Edge, 1982; Harding, 1993; Kelly, 1993; Logino, 1990). O'Loughlin (1992) argued that constructivism is flawed because of its inability to come to grips with essential issues of culture power and discourse in the classroom. Scott (1994) argued that decision relating to planning and teaching for development require the teacher to consider first the nature and status of students' existing ideas and understandings.

The nature of students' existing ideas could be obtained by the application of action research techniques to the classroom. The purpose of

action research has been the study of a social situation with a view to improve the quality of action within it (Elliot, 1991). Action research aims at feeding the practical judgment of actors in problematic situations. The validity of concepts, models, and results it generates depends not so much on scientific tests of truth as on their utility in helping practitioners to act more effectively, skillfully, and intelligently (McKernan, 1988). According to Gore and Zeichner (1991), one of the goals of research is to facilitate the development of the reflective teacher — one who is capable of making both ends and means of education problematic and who can act on the basis of such deliberations. According to Connally and Ben-Peretz (1980), the function of action research is to acquaint the teacher with the techniques of university researchers, making them better "consumers" of research or more willing data collectors, thereby helping to "close the gap" between research and practice. Action research begins with questions from his/her practice, producing its own methods for collecting data (Feldman, 1995; Driver, 1995). In the article "Social Constructivism," Mary Altwater (1996) presents the view of social constructivism bringing additional lens in framing research questions in multicultural science education. According to her science social constructivist's view knowing as a process of students constructing new meanings or making meaning about natural phenomena in sociocultural context instead of students acquiring the meaning of others about natural phenomena. On the other hand, Rivers and Poplin (1995) did

not point out that neither constructivism, critical theory, feminism, nor multicultural education have "developed an adequate way of responding to many of the meanings learners construct." Cummings (1986) identified four areas for science teachers to consider in empowering relationships with students facilitating the learning process. These areas were as follows:

1. Incorporation of students's culture and language in teaching science.
2. Collaborative participation of the community in schools and science classrooms.
3. Orientation of science pedagogy toward reciprocal interaction, and
4. Advocacy rather than legitimacy of failure as a goal for science assessment.

According to Altwater (1996), science teachers do not empower their students, they merely create the situations under which their students can empower themselves.

Educators and researchers have been influenced by the work of psychologists who have studied cognitive development (e.g.; Cazden, 1988; Rogoff, 1990; Rogoff and Lave, 1984; Vygotsky, 1962). It was Vygotsky's (1962) work that focuses on a child's cognitive development as it occurs through social interaction. Cohen and Lotan (1995) focused on elementary classrooms, demonstrated that a teacher's attribution of competence for specific tasks to low-status students in small groups could increase their participation. Richmonds and Striley (1996) acknowledge the struggle of

teachers and researchers was to structure science classrooms so that they provide ways to allow students to assist one anther in developing and expressing critical thinking skills while providing them with sufficient models and support for doing so.

Research provided sample basis for the comprehensive interactions of issues such as language, culture, and "educational vulnerability" of culturally and linguistically diverse children in U.S. society. Garcia (1993) stresses the importance of understanding interactions that exist between students' home and community experiences with language, culture, discourse patterns, nonverbal communication, socialization, and learning styles. Corno and Kanfer (1993) established the importance of volition, a complex set of strategies for turning intentions into effective action such as self-discipline, effort, personal resources, and persistence in pursuit of goals in learning and performance.

One after another researchers in the literature relate a learning process with life experiences deeply connected with their individual social cultural based life. Gay (1992) as well as Banks (1989) noted the high level of consensus about aims and scope in the literature written by multicultural education theorists. Gay points out that there is a tremendous gap between theory and practice in the field. In her view, theory development has outpaced development in practice, and a wide gap exists between the two. Her view is not new. Dewey (1929) established the gap between theory

and practice in the educational field. He established that the proper role of the teacher was to investigate pedagogical problems through inquiry. Dewey (1929) also applied the scientific method and process as logic, or set of principles to be followed in such diverse areas as aesthetics, epistemology, psychology, logic, and education. In his address to the Progressive Education Association, Dewey stated: "Command of scientific methods and systematized subject and matter liberates individuals, it enables them to see new problems, devise new procedures, and in general make diversification rather than set uniformity" (Dewey, 1929).

A major goal of multicultural education, as stated by specialists in field, is to reform the school and the other educational institutions so that students from diverse racial, ethnic, and social-class groups will experience educational equality. Multicultural education theorists are increasingly interested in how the interaction of race, class, and gender influences education (Banks, 1989; Grant & Sleeter, 1986; Sleeter, 1991). According to Banks (1993), a school experience that is multicultural includes context, examples, and realistic images of diverse racial and ethnic groups.

Curt (1984) identified areas that cause particular confusion for Puerto Rican students: proxemics (personal space), occulistics (eye contact), haptics (touching), and kinesis (body movement). Curt reported on a study that found a high rate of retention of Puerto Rican gestures among students raised on the mainland. Students may be retaining more of the nonverbal

than the verbal patters of their parents' native Spanish. The linguistic, cognitive, and social domains of a student's experience have been demonstrated as individually important in understanding the essence of the culturally and linguistically diverse child (Garcia, 1993). Garcia summarized that effective classrooms recognized that academic learning has its roots in processes of social interaction. This type of instruction provides abundant and diverse opportunity for speaking, listening, reading, and writing along with native language scaffolding to help guide students through the learning process (Cadzen, 1988; Tharp & Gallimore, 1989; Trueba, 1987).

The Reflective Approach to Pedagogy

Reflective thinking was defined by John Dewey (1933) as: "Active, persistent and careful consideration of any belief or a supposed form of knowledge in light of the grounds that support it and the further conclusions to which it tends" (p. 673). Dewey (1933) used reflective thinking to mean bringing to mind and considering beliefs and knowledge about teaching. Valverde (1982) provided an operational definition of reflection:

> The teacher must examine his or her situation, behavior, practices, effectiveness and accomplishments. Reflection means asking basic questions of oneself. The basic and comprehensive question during reflection is: What am I doing and why? (p. 77)

The importance of reflective practice is vividly described in the educational research literature. The development of teacher ability to be critically reflective and to learn from his/her own experiences appears in the

literature of Schön (1990; 1987; 1983), Zeichner and Liston (1989), Thayer and Ross (1989), and more recently in the research material published by Killiam (1991) and Feldman (1997; 1995; 1994).

According to Schön (1987), in his writing from "Technical Rationality to Reflection-in-Action,"

> When a practitioner reflects in and on his practice, the possible objects of his reflection are as varied as the kinds of phenomena before him and the systems of knowing-in-practice which he brings to them. He may reflect on the tacit norms and appreciations that underlie a judgment, or on the strategies and theories implicit in a pattern of behavior. He may reflect on the feeling for a situation which has led him to adopt a particular course of action, on the way in which he has framed the problem he is trying to solve, or on the role he has constructed for himself within a larger institutional context. (p. 86)

Schön (1987) argued that when people reflect-in-action, they become researchers in the practice context. Reflection-in-action, he summarized, is central to the art through which practitioners sometimes coped with the troublesome "divergent" situations of practice.

Killiam (1990) presents detailed arguments to support the claim that reflective teaching is an appropriate mechanism for the development of teacher effectiveness in aspects such as clarity and behavior. Killiam's research provided evidence that reflective teaching should be used in all educational teacher programs, enhancing the teacher skills of trainee teachers. Killiam suggested that heightened levels of reflectivity and

consequent improvements in teacher clarity could result from the relative simple forms of structured teacher self-evaluation.

The Reflective Teacher Upon Action: Critical and Self-Reflection

The successful use of self-assessment by teachers in Killiam's (1990) studies support Wade's (1985) findings and provides confirmation of previous findings (e.g.; Hoover & Carroll, 1987; Hillkirk, Tomee & Wanders, 1989) that teachers are learning from their classroom experiences if they are provided with feedback in suitable form, if they possess adequate skills to reflect, and if they have regular opportunities to reflect.

Pelikan (1992) emphasized the value of reflection when he wrote, "To qualify as a 'profession,' an occupation or activity must involve some tradition of critical philosophical reflection, and probably the existence of a body of scholarly literature in which such reflection has been developed and debated" (p. 757).

Feldman (1997; 1994; 1993) described the teacher reasoning perspective focusing on the ways that teachers make decisions about their practice through reflection. He described that there is a wisdom of practice that can be codified in a knowledge base for teaching, the deliberative wisdom that grows through reflection, and the wisdom-in-practice that develops through authentic being in educational situations.

Reflection is a form of slightly distorted self-evaluation — distorted in the sense that judgment is emphasized rather than data collection. The

individual asks value questions and responds on stored selected data and then concludes whether he or she is satisfied or dissatisfied. Reflection then, is an individual's needs assessment and continued self-monitoring for satisfaction with effectiveness. As with any type of evaluation, reflection should be formative, that is constructive and deliberate. This dissertation uses the phenomenological approach for data collection (Seidman, 1991). It is based also in reflection upon action. This leads to the perspective of teaching that draws upon the work of Feldman (1993) known as wisdom-in-practice. In his work the teacher is presented as a wise practitioner, one who can draw upon and add to a wide set of knowledge and can use that knowledge and professional experience to deliberate about and reflect on practice. The teacher is the one who can act wisely within educational situations by reflecting on a growing and deepening understanding of what it means to teach and be a teacher.

Action Research As Reflection

Teachers can investigate their work using action research on classrooms. They acknowledge their work as a human activity. Science teachers therefore recognize that education has validity and meaning only in the context of human co-existence in which it arises (Maturama, 1991). Action research in science classrooms can use the phenomenological approach — a 20th century movement dedicated to describing the structures of experience as they present themselves to consciousness without recourse

to theory, dedication, or assumption from other disciplines such as the natural sciences. The founder of phenomenology, Edmund Husserl (1913), introduced the term in his book, Ideas: A General Introduction to Pure Phenomenology (Lions, 1931). As formulated by Husserl after 1910, phenomenology is the study of the structure of consciousness, which enables consciousness to refer to objects outside it.

This type of study requires reflection on the content of the mind to the exclusion of everything else. Husserl (1913) called this type of reflection the phenomenological reduction. Because the mind can be directed toward nonexistent as well as real objects, Husserl noted that pheonomenological reflection does not presuppose that anything exists, but rather amounts to "bracketing of existence" this is setting aside the question of existence of the contemplated object. What Husserl discovered when he contemplated the content of his mind were such acts as remember describing, and perceiving the abstract contents of the acts which Husserl called meanings.

These meanings, Husserl (1913) claimed enabled an act to be directed toward an object under a certain aspect and such directness called inter-morality is held to be the essence of consciousness. As I research my practice, I am able to reflect on the moral-ethical component being conscious of my inner values and beliefs.

In this action research, I used the phenomenological method of investigation characterizing the teacher that serves as the theme of the investigation. The task is to explain the teacher as being herself capable of standing out as a source of wisdom-in-practice. This wisdom is obtained through a reflective process that links theory with practice. The Greek expression which the term "phenomenon" goes back to is derived from the verb that signifies "to show itself." According to Heidegger (1962; 1926), the expression "phenomenon" is tied to "everydayness." Heidegger described in his book, Being and Time, the way of existing in which the Being manifests itself "everyday." "Everydayness" means the how with which the Being "lives unto the day," whether in all its way of behaving or only in certain ones which have been prescribed by Being-with one another (p. 422). Using Heidegger's theoretical framework, teachers acquire a semblance as Beings through the reflective processes. The Being, in this case the teachers, reflect themselves as practitioners and theorists, developing from their everyday practice what is called wisdom-in-practice. In the phenomenological conception of "phenomenon" what one has in mind that shows itself is the Being of entities, its meaning, its modifications and derivatives. Heidegger describes how a phenomenon can be covered up. In the first place, a phenomenon can be covered up in the sense it is still quite undiscovered. It is neither known or unknown. Moreover, a phenomenon can be buried over. This means that it was at some time but has

deteriorated to the point of getting covered up again. As teachers reflect upon their practice, they can discover hidden aspects that have been covered and deteriorated. They can find new ways of interpreting the phenomena associated with their practice.

Usher (1996) established that to do research in a postmodern way is to take a critical stance towards the practice of sense-making and sense-taking which we call research. He follows by mentioning that there are reflecting questions. He emphasized that as researchers we all have an individual trajectory that shapes the research we do, the questions we ask and the way we do it. Teachers' reflection upon their practice utilized individual experiences, pointing to the importance of the autobiography of the researcher's values, personal interests and own identity.

Teachers act through reflection upon their practice linking theory with practice. It is through these processes that they acquire power to become curriculum makers and curriculum negotiators. Hanna Arendt in her book, The Human Condition (1989, 1958), distinguished between action and fabrication. She emphasized that action is never possible in isolation; to be isolated is to be deprived from the capacity to act. According to Arendt, the only indispensable material in the generation of power is the living together of people. Teachers lived together with their students, feeling themselves confident, treating each other with respect and caring, acting upon their roles and routines, encouraging and exploring their individuality.

This dissertation provides a curricular vision of the classroom. According to Zimwalt (1989), a curricular vision is an orientation that derives from an understanding of the complexity of classroom practice. This understanding views curriculum in a comprehensive manner that acknowledges the interactive, contextual, and evolving nature of teaching and learning, as well as the identity of the individuals involved. The outcomes of this action research are the development and implementation of a model which refers to structure and organization. A model can also refer to conceptual or theoretical orientation.

This action research work established the connection between theory with practice. O'Loughlin (1989) argued that the teachers hold socially constructed beliefs about knowing, teaching, and learning practices and that these beliefs influence what teachers do. Clandinin and Connally (1992) established that teachers' work in schools is a component of curriculum, where curriculum is what happened in schools, where teachers and students interact to negotiate and construct curriculum. Feldman (1997) established that the expert teacher reflects upon practice and can make defensible decisions about educational actions.

This action provided reflections based upon the science classroom. The vignettes recapitulated are specific moments from the past and present experiences of a teacher's mind. These experiences have been vividly reconstructed using diverse methods such as class transcripts, journals,

interviews, observations, and class interactions. The outcomes from such reflective process provided for future anticipation of the teacher's practice, and serve as foundation for enhancing the quality of the overall praxis.

As teachers reflect upon their practice their minds are full of questions. The answers to each one of them are written upon the concomitant processes involving the classroom itself. Teachers need to discover in the practice, the way of bridging theory with practice, and obtaining excellence. The network of practice and performance is complex. On the one hand, teachers need to establish a close relationship with their students. On the other hand, they have to detach themselves from the students, making themselves invisible in order to obtain proper outcomes. In the arena of the practice students come first.

Action research provides the means to evaluate each individual practice to search for answers. Each study from the practice, using action research techniques, enhances the researcher's perception of problems and difficulties derived from classroom experiences. Teachers become experts and resources of wisdom-in-practice. Action research also provides for investigation to be done, suggestion lines of action. Teachers decide which actions will be pursued and monitored systematically. It is said that action researchers learn how to use observations and reflection designing proper changes in their routines facilitating further actions. The analysis of the existing conditions in the practice permits that teachers started the adequate

experimentation with alternate approaches initiating the exploratory and developmental cycle (Deforges, Lockburn, & Bennett, 1993).

Deforges, Lockburn, and Bennett (1993) suggested that each case using action research, the motivation is personal, the methods are simple and the intentions practical. The starting point for change is the teacher's sense of dissatisfaction or frustration with certain aspects of the existing conditions in the practice. Action research in the classic sense permits that each single teacher perceives a problem or difficulty in the classroom experience. Teachers' investigation suggested lines of action, and perhaps the most critical function of action research is to articulate the interpretation framework in which an issue is conceived. As Deforges, Lockburn and Bennett established: "The important point is that action research goes beyond local troubleshooting for the record to show and accumulation of knowledge from this endeavor, making explicitly, the articulation, analysis and justification of the grounds of action" (p. 97).

Lawrence Stenhouse (1964) saw teachers' accounts as providing a pack of specialized case studies, as in medical practice, to which the practitioners faced similar "symptoms," might refer. If action research is to play a more enduring role in teachers' professional lives it seems essential to make it part of every teacher's job description and its successful prosecution part of the teacher's career structure. The conceptual basis of action research requires that we revisit the historical years that link action research

and reflective practice. According to Ian Bryant (1996), action research has only fifty years of history. Commentators are generally agreed that this research had its origins in wartime operational research and the post-war development of Kurl Lewins' (1948) theories of change in formal organizations.

The final purpose of this qualitative research is to focus on my own performance as a teacher describing what is happening in my multicultural science classroom. The research relies on the fact that only through the use of action research methodology is it possible to describe the ongoing process occurring in my classroom.

According to Carr, Ward and Kemmis (1988), the object of action research — the things that the action researchers research and that they aim to improve — are their own educational practice. Feldman (1991) described the action research process as teachers engage in a systematic approach in which they inquire into their own practice by taking action within their own educational situation. The main purpose of this study was to identify the multiplicity of components that produce effective science pedagogy.

Conclusion

The study focuses on the ongoing process in the multicultural science classroom that facilitates my development as a science educator. The identification of the components related to science pedagogy serves the purpose of my development as a multicultural science teacher. The study

provides a written document that describes my process toward wisdom-in-practice acquisition. The study serves the purpose of creating a social prism that conveys the multiplicity of interactions occurring within multicultural science classrooms.

"The purpose of action research for teachers is to come to a better understanding of the education situation so they can improve their practice. They want to be wiser, and wisdom lies in action" (Feldman, 1993, p. 341).

The final outcome of this research is the clarification of the moral-ethical values that sustain my overall practice. This process is finally conveyed in the identification of my teaching style, together with the identification of the strategies that support my final arrival to wisdom-in-practice. This study served the purpose of declaring vivid responses to outside stimulus that affect my classroom practice. In other words, using action research techniques and methodology, I, as a researcher, was engaged in the study of personal, social, ethical and historical issues that affect my performance as a science educator. During this evaluative process, I was confronted with the strengths and limitations of my overall practice. This study used action research to describe a process that never ends the teaching and the learning process. Therefore, the use of action research in my practice produced results that provide in-depth and further growth in my development as a science teacher. This process affected my overall life resulting in wisdom-in-practice.

"Action research begins with a period of critical reflection, followed by planning, action, observation, and reflection" (Kemmis & McTaggard, 1988, p. 22).

CHAPTER 3

METHODOLOGY

Introduction

The biographical background of this action research study started from my search as a teacher as I identified the concomitant factors associated with teaching and learning. It started with a pilot study considering the factors related to learning from a Piagetian point of view. It subsequently follows the avenues of inquiry and experience from Dewey's contribution to education. In this search for understanding teaching and learning I revisited my previous experiences as a teacher. After finishing the pilot study, I was advised by my dissertation committee to consider and further develop research from a teacher's point of view. This dissertation study represents my intention to follow their advice further linking theory with practice.

This chapter includes a description of the research design utilized in this action research study, as well as the justification for its use. It also includes an overview of the sampling methods, data instrumentation, data collection, procedure, methods, and data synthesis employed.

The process of action research begins with finding a question that is meaningful and important for the researcher. The process follows by revising and reading the literature that covers the research topic and

planning the overall strategy. As the researcher collects data, he/she tries to refine the methods, trying to focus on the topic of inquiry.

The researcher follows the cycle making sense of the data reaching conclusions about the research questions as he/she tries to find practical significance to the findings. The final steps of the process presuppose taking action based on the conclusions in order to share the findings with others. In short, the process of action research involves that the teacher takes action on his/her practice reframing the classroom situation, experimenting with it, and detecting the consequences on his/her practice to improve it (Schön, 1995; Feldman, 1994).

According to Altrichter, Posch and Somekh (1995), in action research there are four important objectives:

1. To develop and improve practice through research in the interests of all concerned
2. To develop the knowledge and practical understanding of those involved in the research process
3. To develop the professional knowledge of teachers as a whole
4. To develop and improve education as a discipline

Action research is characterized by spiraling cycles of problem identification, systematic data collection, reflection, analysis, data driven action taken, and finally, problem redefinition. The linking of the terms "action" and "research" highlights the essential features of this method trying out ideas in

practice as a mans of increasing knowledge and/or improving curriculum, teaching, and learning (Kemmis & McTaggard, 1982).

This action research study focused on my development as a practitioner of science pedagogy, describing the means of interaction between theoretical knowledge and the application of such knowledge to my day-to-day practice. This process was done through a critical reflective process which is the trademark of the teacher researcher (Atwell, 1991). The study includes the use of my KMEEP model, its design and implementation within the multicultural classroom, together with its overall use in explaining the teacher learning processes.

Using action research, I revised my own identity as a science teacher, writing my own autobiographical interviews, searching for answers in the hidden methodology design for teaching and learning. As a true action researcher, I looked into my past, remembering my decisions and identity as a teacher. I described my performance as a teacher from a day-to-day experience. I revised my constant thrive to become a better teacher, projecting and predicting my future performance as a science educator. My action research was:

> A compelling summary of what happens when teachers conduct research as a regular part of their roles as teachers: The teaching is transformed in important ways: They become theorists, articulating their intentions, testing their assumptions, and finding connections with practice (Goswani & Schultz, 1987, p. 58).

Action research is not a static process; it is a living process. As a science teacher, I provided evidence from my practice about the way the educational process develops in my classroom through the multiplicity of views focusing on my own performance. The core of this study is the description of a teaching-learning process that is content-based in a multicultural classroom. In this study I search for answers within the context that helps define the linkage between science education theoretical frameworks and the practice. The process of knowledge acquisition follows a path through the reflective memories of the teacher until the final demonstration in the effective science classroom.

Action research provides the methodology for the reflection of the philosophical ideas that sustain effective practice. It also provides for the examination of qualitative research, past actions, and research projects.

> "I learned as a teacher that theories were implicit in all practices, and that theorizing consisted of articulating those 'tacit theories' and subjecting them to critique in free and open professional discourse" (Elliot, 1991, p. 6).

In this study I search for ways to establish a bridge that links theory with practice in my own multicultural classroom. The study provides for the screening, identifying, and preserving of overall teaching learning experiences. Since its beginnings, action research is described as a systematic, collaborative, self-reflective and critical process. Stenhouse (1975) suggests the concept of a critical friend which helps portray colleagues in the teaching and doing of action research as collaborators and

critical connoisseurs of each other's work (Eisner, 1994). This case study narrative serves the purpose of describing what was going on in my classroom and in my mind as I reflected in the pedagogical procedures developing daily lessons. This study provides the means of using action research to grasp a view of my inner self as I performed as a science teacher. The study serves to unveil the motivational aspects that affect my practice providing for the development of wisdom-in-practice.

This study provides for an open view of myself and the imagery surrounding my practice. This was be done by illuminating my practice, creating a living portfolio of images. Each image obtained from the classroom serves the purpose of describing a process of teaching-learning that requires creativity enhancing effective science pedagogy. Action research provides for the recollection of data that perpetuates a series of classroom interactions and relationships, that otherwise would be lost. It provides for describing both the inner and outer surroundings of a healthy practice. This study identifies growth, development and change as I searched ways of becoming a better teacher. Each case situation helps to create a vision in my classroom providing for analysis, and evaluation of the results in teaching and learning science. In the study I departed from the "We," to find the "I."

This study contains the revision of the self, which constitutes the most difficult and valuable aspect of this scientific endeavor. To define the

self, I searched for my inner chord, for the identity that makes me a being. In this search I looked for my moral-ethical fiber. In order to obtain this goal, the study included the revision of my educational background, together with my own beliefs and value systems. This study uncovered my anchor system as it permeates in the science classroom environment. The study included revision of my goals and objectives as science teacher, together with classroom management techniques, content knowledge, lesson planning, and the strengths and weaknesses that are inherent to my inner being. In this study, I searched for the roots of my own communication skills, trying to discover how to create a proper environment for learning. Action research helped me discover the network of interactions needed for constructing a collaborative and cooperative atmosphere within the multicultural science classroom. The final result of this creative approach was wisdom-in-practice. This study centered in the acknowledgement of the individualized patters of social learning that should be used in effective science pedagogy. The study exposes the interactions occurring in the classroom as the effective teacher uses insights into the students' learning processes.

> A characteristic of the approach to action research that we favor is that the teachers focus on their own practice not that of others. The teachers can be thought of as being the subjects of their own research (Feldman, 1993, p. 83).

Action Research: Explaining How the Action Occurs

This study includes context examples and realistic images of a very diverse and unique population. The students and I as a teacher perform in a multicultural science classroom in an urban city high school. The study is embedded in a theoretical model where the developmental phases interact within the sociological context, reaching equilibration in effective science pedagogy. I articulate my personal constructions and understanding of the classroom practices. I describe further development of my personal constructions and understanding of the classroom practices I negotiated new meanings in the science curriculum. Action research serves the purpose of providing for a continuous and active exploration of the classroom arena. It helped me to enlighten the overall panorama of teaching and learning. It is the major force behind the production of the major changes needed on the practice. Action research encourages and stimulates the development of theoretical frameworks that sustain the educational process.

Design of the Research Experience

The design of the research experience was inspired by the action research models proposed by Feldman (1993) and Schön (1987; 1983). The study focuses on a model that constitutes a series of idealized phases of a cyclical process linking theory with practice.

Feldman (1996; 1993) suggests that for researchers to come to a better understanding of teachers and teaching, it is necessary to interact

with teachers in ways that allow researchers to make meaning of teachers' understanding in their educational situation.

According to Schön (1987), the process by which practitioners construct knowledge remains unknown and is mostly implicit. Schön understands reflection in action as a conversation between the situation and the individual. Schön provides the following phases for the process of reflection on action: a) reframing the situation, b) experimenting with the situation (conversation), and c) detecting consequences.

In reframing the situation, the problem is analyzed, and then is approached in a different way. New directions for thinking and acting are suggested by the new frame of reference. In experimenting with the situation (conversation) practitioners conclude experimental approaches for different situations. Schön's (1983) approach assumed that these experiments took place intellectually.

According to Feldman (1983), the expert teacher reflects upon practice and can make defensible decisions about educational actions. Feldman argued that the task of the teacher is to use a variety of methods including video tapes, portfolios, and post hoc reasoning protocols.

Action Research: Storytelling A Classroom Story

The study served the purpose of providing a written documentation of the happenings occurring in the multicultural classroom. It constituted a

narrative in a very descriptive way, starting from knowledge acquisition, to construct a bridge that links theory with practice.

This study provides the teacher's insight into the overall process of teaching, not from theory alone, but from the interactive processes in the teacher's mind and her unique classroom. Action research produces the clashes between two very definitive worlds, the theoretical and the practical one. It tells the story of survival, of conflicts, of successes, and of defeats that are a comprehensive part of a teacher's career. Action research provides for the analytical and microscopic view of life in a science classroom, describing the continuous pressures that are exerted on a teacher that tries to reach the heights of excellent performance using her own unique KMEEP model design for the multicultural classroom.

The strength of the storyteller relies upon the teller's ability to introduce his view to the audience. The storyteller has to describe each scene with vivid details so that it becomes alive. This study enlightened both the theoretical ideas behind the standards and frameworks in science pedagogy and the proper identification of specific features from the classroom experiences.

In this dissertation I describe the academia and classroom clashes, the conflicts that are not evident to the outside world. Only to action researchers do the distinctive features of assessing performance in learners become tangible. The study enlightened both the theoretical ideas behind

the standards and frameworks in science pedagogy and the proper identification of specific features from the classroom experiences. The study describes the academia and classroom clashes, the conflicts that are not evident to the outside world. Only to action researchers do the distinctive features of assessing performance in learners become tangible. The study is innovative in the sense that it is a continuous creation of a bridge that links theory with practice. As an action researcher, I searched for answers within the learners because the process is student-centered. I also searched for answers within myself with the sole purpose of becoming a better teacher that makes the process teacher-cantered.

In this study the teacher was placed in the witness stand, describing what occurs in the multicultural science classroom. This study dichotomizes theory and practice, studying each single phase, and later places together each single brick describing a process that is alive and very dramatic. The storyteller, namely the teacher, voiced a true case study that delimits the fine line between the overall theoretical world and classroom practices.

Action research is not new; it has served the educational field for many years. The newness in this study constitutes the departure from a theoretical sea of knowledge to the arrival of the practical contribution of the classroom. This enriches the teacher's performance, providing answers to common problems related to her practice. Action research empowers the teacher to relate the theoretical world with that of the practical one. The

teacher acts, reaching a level of performance not designed by outsiders but by her own insight on the practice. The teacher departs from prescriptive methodology, and is expected to be able to develop her own methodology.

This action research describes the fight of a single teacher to be recognized as the author of her own destiny in science pedagogy. It is centered in action research, as the teacher strives to build a bridge that links theory with practice. This construct of her own design was used in the negotiation table, as she departs from routine. Teachers are almost always identified as followers of theories but not as creators of them. This action research study presents a theoretical view that links performance with effective classroom practices. It describes the origins of a model from the classroom. It delimits effective classroom strategies, and also identifies existing limitations. The study describes the process of a teacher in her search for her own identity in excellent performance teaching science as she arrives to wisdom-in-practice, taking control of her final destiny as a science educator.

The present study is designed to examine the following questions:

1. How do I develop wisdom-in-practice and become a curricular designer and negotiator using action research?

2. How do I use wisdom-in-practice to teach in the multicultural science classroom?

In particular I examine questions such as: "How do I as a teacher find the proper balance between students and the rest of the components of the environment such as administrators, teachers, parents, community leaders, and others?" and "How do teachers survive the continuous pressures of situations they cannot control?"

The term wisdom-in-practice is used in this study according to Feldman's (1997) definition of the term in his article "Varieties of Wisdom in the Practice of Teachers." The term wisdom-in-practice is used as the teacher knowledge, reasoning and understanding that lead to practice wisely. Feldman concludes that: "There is wisdom of practice that can be codified in a knowledge-base for teaching, the deliberative wisdom that grows through reflection and the wisdom-in-practice that develops through authentic being in educational situations" (p. 757).

In the topic "Teaching, Researching, and Assessing the Wisdom of Teachers" included in the article Feldman (1997) summarizes.

> In this paper I have looked at different ways to conceive of teachers and teaching. The first perspective, teacher knowledge, suggests that the route to good teaching is through the accumulation and generation of wisdom of practice. This

> wisdom consists of sets of knowledge, where knowledge is conceived as a commodity that is modifiable and can be accumulated. The teacher reasoning perspective suggests a different route — that good teaching comes about through reasoning about practice and in practice. It downplays the importance of accumulated knowledge while recognizing wisdom as the ability of individuals to make defensible decisions. (p. 770)

As a teacher using action research, I focused on the holy trail of wisdom-in-practice that previous practitioners have left behind to be used in the form of codified theoretical frameworks. I derived from my practice the vivid examples that wisdom can be accumulative knowledge that helps teachers in their daily performance as decision-makers.

Research Design

As relational research is often used "to describe the regularities or patterns between predefined phenomena" (Smith, 1999, p. 40), I used action research to describe the relationships between the processes of teaching and learning. This research is descriptive and relational. This study is a single case study examining the diverse components of the teaching-learning process.

In this study I focus on my practice as a high school teacher searching for my identity as a curriculum negotiator and designer. This process led to further development of my wisdom-in-practice.

This action research study is influenced by who I am as a teacher and researcher. I was born and raised in Puerto Rico, the daughter of a science

and math educator. My father provided an excellent paradigm dedicated to reaching students at risk.

I visited his classroom many times, learning the value of using diverse strategies in teaching. I attended public schools in Puerto Rico and there entered the university when I was only fourteen years old. I finished the university when I was eighteen years old with a bachelor's degree in science. I came to the Untied States, finishing my second degree in education. It was in this country that I participated in the civil rights movement, influencing my visualization of the role of education reviving the soul and thought.

I returned to Puerto Rico, finishing my graduate work and was appointed to teach as educational coordinator in the medical sciences department in the area of medical technology. I served as professor for six years, devoted mainly to teaching in many areas in pure sciences and applied sciences. It was during these years that I discovered that education could be used to change the democratic social order, as I engaged in political issues related to my country. This component added a new dimension to my thinking. I was living a three-dimensional career in the areas of science, religion, and education.

I moved back to the United States, starting to teach at the high school level. My previous insights in the educational field helped me to relate to my students in both the cultural and scientific levels. Science

education became the heart of my life, as I searched for meaningful ways to convey scientific knowledge to my students. I knew that science education requires content knowledge that doubles every two years. My philosophy of education was developed during these years. I believe in a student-centered science education, where teachers and students share a common goal. I discovered that students and teachers interchange their roles at different moments as they learn and teach each other. The student becomes the teacher, the teacher becomes a learner. It is within this environment that the reflective practice is so valuable.

This study enabled me as a researcher to grasp from my practice the concomitant factors that surround the teaching/learning processes. This helped me in the process of clarification of my values and beliefs, as they are expressed in the educational practice.

I am the object and subject of this action research study. I have taught students in grades nine through twelve in the areas of Physical Science, Biology, Chemistry, and Physics. I hold two bachelor's degrees (BSM.T., B.A. Ed.), a master's degree and am currently finishing a doctoral degree in education. I have taught in public and private sectors in the educational field. I am a Phi Delta Kappa fellow and member of the Accreditation Committee of my school. I have taught at the university and participated in multiple research projects. I have performed as continuing education director in my field of expertise.

Overview

Action research is concerned with adding to the body of knowledge in regard to teachers' practice. The intent is to improve one's own performance by means of identifying the factors related with teaching and classroom situation learning. The process of action research involves the teacher taking action on her own practice, reframing it, in order to improve it (Schön, 1995).

In this study I used two types of data collection for researching my practice: the phenomenological approach (Seidman, 1991), whereby I was the participant of a series of in-depth interviews, and the reflective approach.

Using the phenomenological approach I served as the theme of investigation considering my biographical past, my present, and my future anticipated educational processes. The term "phenomenon" is derived from the verb that signified "to show itself." According to Heidegger (1962, 1926), the expression "phenomenon" is tied to "everydayness." Heidegger described in his book, Being and Time, the way of existing in which the Being manifests itself every day. "Everydayness" means the how with which the Being "lives unto the day," whether in all behaviors or only in certain ones which have been described by being with one another (p. 422).

The phenomenological approach served the purpose of uncovering my biographical antecedents and teaching strategies. The interviews provided

for the identification of the concomitant factors that affect my identity as a science teacher. The data obtained from these interviews provided the information for each research question.

As an example, the historical/biographical interviews uncovered models that serve to shape my teacher identity. They also allowed for the identification of the concomitant factors that affect my identity as a science teacher. The data obtained from these interviews provided the information for each research question.

The reflective approach (Schön, 1985; Feldman, 1995) consists of the use of journals, documents, and observations of a series of classroom interactions, cross-checking eyewitness examinations of the classroom practices. The reflective approach is a mode that integrates or links thought and action with reflection. It includes thinking about and critically analyzing one's action with the goal of improving one's professional practice.

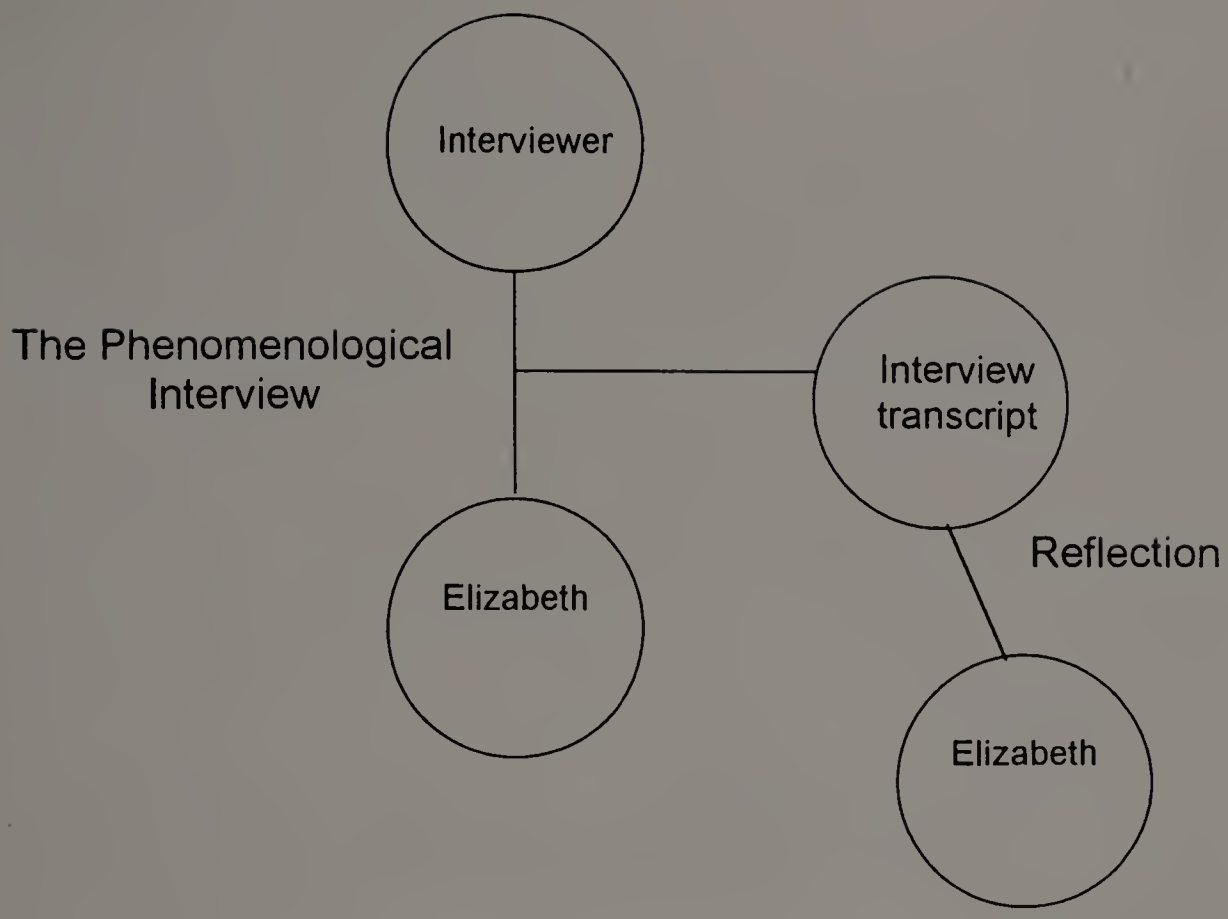


Figure 1. The phenomenological approach

The Phenomenological Approach

Using the phenomenological approach (see figure 1), I was interviewed to search for my individual teaching and learning styles, and my beliefs about teaching and learning. The data obtained from the interviews are triangulated with the data obtained from the reflective approach.

Schedule of Interviews

Number Interview Component

I. Historical/Biographical

II. The Present

III. The Meaning

Description of the Interviews

1. Historic/Biographical Antecedents and Content

   I was interviewed using a semi-structured interview protocol. I was interviewed about biographical antecedents and teaching styles that affect my teaching learning processes.

2. The Present

   The interviews were conducted in order to reconstruct my individual teaching processes to identify the basic components that I associate with adequate science teaching.

3. The Meaning

   The interview questions lead me to reflect about my past and future as a science educator.

The interviews served the purpose of allowing me to reconstruct my experiences as a teacher within the multicultural classroom. The interviews also uncovered my teaching-learning processes, provided information about myself as a teacher and reflected major strengths and weaknesses. The interviews focused on myself as a teacher as I searched for teaching strategies in a science classroom environment.

Each interview provided for the proper understanding of the main factors of my practice. The interviews served the purpose of clarifying the major changes needed for the teaching-learning process to occur.

The phenomenological approach interviews helped me as a teacher to clarify my goals to find wisdom-in-practice in my day-to-day teaching. The use of interviews identified the significance of events that mold my teacher character. The final outcome of the process resulted in me, as a teacher, having a clearer view of myself as a practitioner. The better perception of my identity as a teacher provides for future development as a science educator.

I have three main reasons for the use of interviews:

1. The interviews are a form of conversational research.

According to Feldman (1999) in his paper "Role of Conversation in Action Research," knowledge growth occurs using conversation as a research tool. As an action researcher, the interview provided for further insight and reflection in the teaching-learning process. He defined

conversation as: "Conversation is a dialectical process as the participants share knowledge, views, understandings, and feelings, while relating all contexts and contingencies of personal and political history" (p. 132).

"Conversations occur among people, are cooperative, have direction, result in new meaning, and are not governed by the clock" (Feldman, 1999, p. 133).

2. The interview causes the interviewee to make explicit ideas, memories and values that would not come out from merely reflective writing.

3. Reflection on the transcript allows for a second level of reflection. This helped me to uncover aspects of my wisdom-in-practice.

The Reflective Approach

According to Schön (1988), the stage is set for reflection when "knowledge-in-action — the sort of knowledge that professionals come to depend on to perform their work spontaneously — produces an unexpected outcome of surprise" (p. 89). This surprise can lead to one of two kinds of reflection: reflection on action, which occurs either following or interrupting the activity, or reflection in action, which occurs during (without interrupting) the activity by thinking about how to reshape the activity while it is underway.

Kottcamp (1990) uses the term "offline" to distinguish between reflection-on-action and reflection-in-action. Reflection-on-action takes place after the activity (i.e., offline), when full attention can be given to analysis

without the necessity for immediate action and when there is opportunity for the professional to receive assistance from others in analyzing the event. Reflection-in-action occurs during the event, and may be more effective in improving practice.

The Reflective Approach to Pedagogy

1. A series of interviews were performed using the phenomenological approach (Seidman, 1991).

   The transcription of ninety-seven pages permit the selection of sixteen excerpts that provide information from the practice. This information was obtained using the reflective in action approach, permitting:

   a. Establish a teacher sense of identity

   b. Develop the teacher sense of identity into becoming a wise practitioner

   c. Develop the teacher identity in becoming a curriculum negotiator and a curriculum designer

2. The excerpts were revisited, a collection of reflections were analyzed and classified obtaining the teacher's personal teaching style.

3. Each reflective process was used to establish the link between theory with practice.

As I researched my practice, I used the reflective approach to pedagogy as a research method to establish a link between theory and practice. Using this methodology, I was able to identify, describe and

reproduce the teaching-learning process, explaining the procedural steps using the KMEEP model for science education. The reflective process contributed to the development of a sense of identity with my practice.

The reflective approach helped to uncover the development and use of my wisdom-in-practice as I found ways to integrate content knowledge with every day practical situations in the classroom. The reflections produced creative and innovative solutions to classroom problems.

In the Reflective Approach I used the following methods: a) Use of journals (Reframing the situation, b) Conversations with colleagues (Experimenting with the situation), c) Classroom observations (Detecting the consequences), and d) Use of portfolios, videos and other techniques.

This approach was based on Schön's (1985) and Feldman's (1994) work. The most valuable outcome from this approach was that I developed a sense of identity with my practice. Using the reflective process, I was able to identify the theoretical framework that sustains my practice and influences the development of my wisdom-in-practice.

Using this approach I was able to identify and reproduce my own teaching processes and explain the procedural steps using the KMEEP model. This model was used to help answer the research questions. The first question, "How I develop wisdom-in-practice," was answered using the four components of the teaching process that I identified in my pilot project. These components are Component A (Self-esteem), Component B (Moral-

ethical), Component C (Social), and Component D (Historic-episetemological). The second question, "How do I use wisdom-in-practice to teach in the multicultural classroom, is answered using my KMEEP model, which stands for Knowledge (Content Knowledge), Memory (Long-term and Short-term Memory), Experience (Experimental Process), Evaluation (Appraisal), and Performance (Assessment), components necessary for the teaching-learning process to occur.

According to Schön (1985): "Underlying the view of the practitioner's reflection in action is a constructivist view of the reality with which the practitioners deals, a view that leads us to see the practitioner as constructing situations of his practice" (p. 97). The process of dialectic reflection (see figure 2) in this dissertation helps me in the identification of the following components.

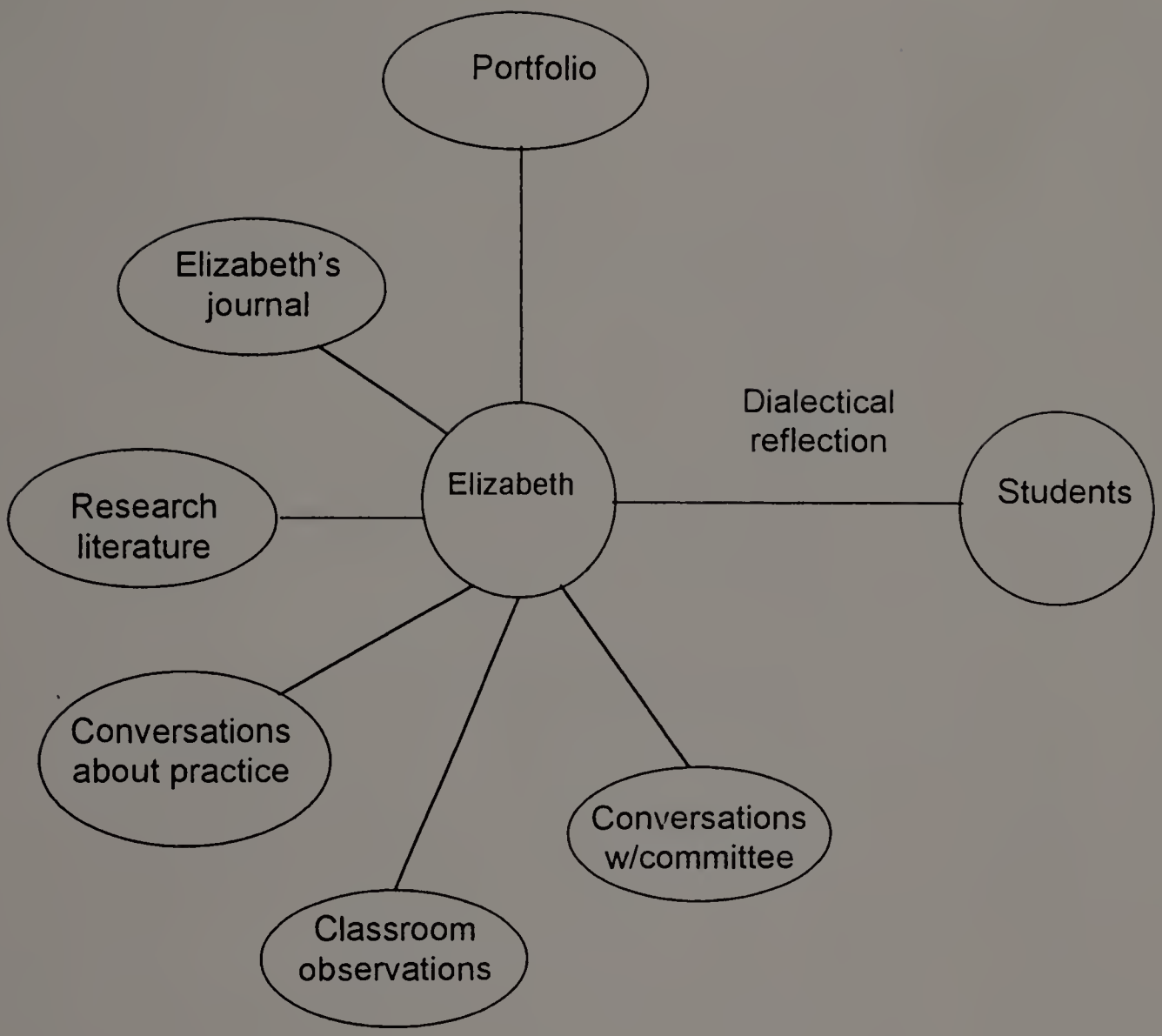


Figure 2. Dialectical reflection

Use of Journals (Reframing the Situation)

The self-developmental research of the practice would be lost if I, as the teacher, did not write and describe the processes and activities that happened in the classroom. Reflective practice is a mode that integrates or links thought and action with reflection. It includes thinking about critically analyzing one's action with the goal of improving one's professional practice (Holly, 1997).

The purpose of journals is the preservation of insights in a particular situation, which are the classroom and its components, teachers and students. Engaging in reflective practice requires individuals to assume the perspective of an external observer in order to identify the assumptions and feelings underlying their practice and then speculate about these assumptions and their effect in the practice (Kottcamp, 1990; Osterman, 1990; Peters, 1991). The use of a journal allowed me to do this.

The importance of using journals is three-fold. First, it permits me as the teacher to gain insight and understanding of my situation. Second, it allows me as a researcher to return to the events of interest, examining them from different perspectives. Third, it provides the historical continuance of a vivid process.

As a researcher, I value the journal process that helps me focus on particular events in my practice. The journal is the written document that facilitated the reflective process. Schön (1985) states that when reflecting

in action, a professional becomes a researcher in the context of practice, being freed to establish theory and techniques to construct a new theory to fit the unique situation.

I used a reflective journal for the purpose of reframing the situation. In this journal I identified the activities that I observed and participated in while in the science classroom. This served the purpose of helping me to reflect about materials, occurrences and situations on a day-to-day basis. I reflected on the questions: What happened? How did I feel about it? What did I learn?

I read the journal, revising and reflecting on the observations of my practice. I used the journal to help me clarify issues as I reflected upon my thinking. This enabled me as a teacher to discover new problematic areas and to search for possible solutions.

As I reframed the situation, the journal made me aware of my thought processes. It helped me to reflect about how I teach presenting the conflicting areas. This process permitted me as a teacher to revisit the situation, focusing on the experience and creatively make the necessary changes. I used the critical and reflective questioning for this purpose.

I made notes about my responses and interpretations, analyzing the classroom processes. The journal entry included comments, questions, connections, or analysis of previous situations. I revised past experiences and planned for future applications, reinforcing my classroom strategies.

The journal entries provided the opportunity for writing down anything that occurred in the classroom. They served the purpose of helping me discover issues and problems reflecting about something that happened in practice.

The most important part of this process was making connections about my own experience as a science teacher. I searched for similarities between concepts and events. I asked questions about particular incidents. The journal entry initiated a dialogue with myself. I reframed what happened in the classroom with words, images, phrases, and details. I examined the main events and speculate about possible long-term effects resulting from such events, anticipating the effects of the events experienced. All this helped in answering my two main research questions.

A Vignette for Illustrative Purposes

Journal Entry Day 1

It is great to be back! This day's preparation started a few weeks ago. After much revision, I finally organized the materials needed for the school year. I also prepared portfolios for the classes assigned to me for this year: Biology, Physical Science, and Physics. I organized my professional notebook, the homeroom materials, and the substitute carpet.

The starting day arrived, and I was ready for my students. The first morning was dedicated to providing orientation to ninth grade students. I organized my classroom for cooperative and collaborative experiences. I

also prepared a student handbook which contained instructions for day-to-day classes and laboratories, a class syllabus, and expectations. I prepared a long list with information for the students because I knew they would ask questions. During the morning I was able to organize materials, check textbooks, and make preparations for the students' arrival.

When the students arrived I introduced myself. I try to know my students, using a classroom dynamic. I let them introduce themselves to their peers as they participate. I follow the dynamics with a statement which I call the rules of the game. The "breaking the ice" dynamic works. This year I selected one called "The Situation." I observed the students as they engaged in various interactions. It seems that this year more one-to-one interactions will be possible than were the previous year. I remember last year and the inherent difficulties in the classrooms, however, time and planning have changed these things.

A new teacher was added to my department, my expectations became a reality. Every issue has two sides.

I remember my creativity class and the word I describe Janusian, the Roman god with two-sided vision. I miss my students. I prepare and plan for the upcoming days. It seems very different this year. I wonder what will happen this year. I anticipate great things!

Conversations About Practice

(Experimenting with the Situation)

I participated in conversations about the sequence of instruction based upon goals and objectives to be achieved. The importance of conversation as a research tool has been stressed in the work of action researchers (Feldman, 1997; Cochran-Smith & Lytle, 1996) due to the knowledge and understanding that can be derived through conversations. I revised the congruence between science standards and classroom practices. I emphasized understanding the structure of my own teaching processes and prescribe learning activities. I emphasized the importance of adapting instruction to the experience or interest of my students, acknowledging individual differences and cognitive styles. The outcomes of these conversations were recorded in a journal.

Classroom Practices (Detecting the Consequences)

This study used a series of classroom observations, cross-checking eyewitness accounts of classroom practices.

This study included the results of on-site observations done by administrators, colleagues and peers together with excerpts from evaluation forms and reports that describe the practice. The observer used a protocol to guide the observation and the report process.

The following summarizes reflective process that can be obtained through observation of classroom practices (Roth, 1989):

- Seeking alternatives
- Keeping an open mind
- Comparing and contrasting
- Seeking the framework, theoretical basis, and/or underlying rationale
- Viewing from various perspectives
- Asking What if ...?"
- Considering consequences
- Hypothesizing and restoring problems
- Questioning what, why, and how one does things and asking what, why, and how others do things
- Using prescriptive models only when adapted to the situation

Use of Portfolios

I developed my own portfolio using the outcomes of the reflective process. The portfolio included the results of my own reflections in the development of my educational philosophy. The portfolio development included the following steps: collecting work for the portfolio, reflecting on work for the portfolio, selecting the work for the portfolio, projecting into the future: goals and work for the portfolio.

The use of the portfolio induced reflection on experiences and the application of experiential learning to activities carried out as part of my own profession. This emphasized improving my practice as I participate in a sequence of actions i the research spiral. The portfolio permitted me to

incorporate the latest educational research findings into all aspects of instructional design processes evaluating performance.

Revising the Action Research Process

As an action researcher, I revised my own action research process, searching for details of my own construction. The word "construction" means in this study the overall creative process of using diverse techniques and strategies to enhance learning. I searched for patterns of interactions between the diverse processes occurring on a daily basis. I used the help of an experienced action researcher for this process.

The revision process provided for an adequate focusing on the diverse steps of the action research cycle, obtaining vital information through data analysis. The process of revising is different from the other steps because in it the action researcher explores all the phases of her own construction, searching for strategies in teaching. The adequacy of these patterns of interaction enhance the practice, permitting for necessary changes and adaptations.

The use of action research in this study helped me in the process of establishing relationships with the concepts of several educational experiences in my life. It helped me revise, develop, and use my KMEEP model. This model was used to explain my own process as a teacher and learner. A model is an idea, system, or structure that represents whatever you are trying to explain. The model is never exactly like the thing being

explained, but similar enough to allow comparisons (McLaughlin & Thompson, 1997).

As I researched the literature used in conducting this study, I came in contact with different types of actin research such as traditional action research, collaborative action research, participatory action research, technical action research, practical action research, emancipator action research, and critical action research. This study reflects the characteristics of traditional action research. This context helped me in my development as action researcher contributing to further development of wisdom-in-practice.

This action research study allowed me to notice patterns that occur in my practice, as I become a wise practitioner discovering a new role as researcher. As a science teacher researching my practice, I examined my practice from outside, being the object of the study. I was privileged to be inside the classroom and have access to my students.

Data Analysis

According to Altrichter, Posch & Somekh (1995), analysis is the process of making use of the data to construct meaning. This construction of meaning is accompanied by critical examination of the analytical process. They describe the constructive methods of data analysis as making data summaries, developing categories and coding data, writing critical notes, quantification, shaping metaphors, testing the findings, pattern analysis, and dilemma analysis.

For the purpose of this study I used the following: a) data summaries, b) writing critical notes, c) shaping metaphors, d) pattern analysis and dilemma analysis.

a) Data Summaries

This data analysis method consists of reviewing the data collected and writing a summary. I used the tape recordings of the interviews and the observation notes from the journal to get an overview of the situation.

b) Writing Critical Notes

According to Altrichter et al. (1995), critical notes help us move beyond the details of events to a conceptual level, developing theories, uncovering relationships and finding significance.

I used the data obtained from the interviews, observations and portfolios to search for the meaning of the data how facts could be explained, and how important concepts could be defined, to uncover my development and use of wisdom-in-practice.

c) Shaping Metaphors

A metaphor transfers meaning from one field of experience often a colorful one) to another (often an abstract one). For example, I transferred meaning from the field of physics to the abstract field of educational research. I used the metaphor of the reflective mirror to describe the process of action research. I used the metaphor to help

me analyze the process of action research widening my horizon trying to get a better understanding of myself as a teacher.

According to Reiners (1961), metaphors are valuable only if they come to mind naturally. I used the metaphor to stimulate new directions in my developmental research process.

d) Pattern Analysis

Patterns are regularities or forms of interaction which occur over and over again (Ireland & Russell, 1978). I used pattern analysis to interpret data as I inquired about the nature of teaching and learning. Each annual pattern revision served the purpose of identifying rooted attitudes, which are keys to abetter understanding of teaching. The annual revisions related to curricular revisions done within the system. This annual revision gave me as the teacher enough time to incorporate the projected changes. I searched for patterns in my in-depth interviews and related processes. I found the significance beyond the data itself. I used the pattern analysis to develop new strategies to improve teaching and learning.

e) Dilemma Analysis

Dilemma analysis is based on the notion that teachers are continually faced with dilemmas that require professional decision-making (Winter, 1983). I worked on dilemmas to solve them where possible. I used dilemma analysis to help me identify and value minority views

in my teaching and learning processes. I also looked for the dilemmas in my practice and seek their meaning in relation to my KMEEP model, which I used to explain the teaching-learning process in the classroom.

Evaluation of Outcomes

I searched in this study for my responses to the following research questions "How do I develop wisdom-in-practice and become a curricular designer and negotiator using action research?" and "How do I use wisdom-in-practice to teach in the multicultural science classroom?" I searched for certain ideas, objects, persons or situations that helped me improve my practice. This provided for the identification of the opinions and beliefs that sustain my practice. This helped in the identification of attitude changes that are needed to obtain a better performance in the classroom. I described consistency among my own beliefs as I searched for possible attitude changes.

I evaluated my own individual ways to process information as I detected consequences. The process helped me as I identified abilities using diverse teaching strategies, modes of thinking, and peak performance in problem solving situations. I detected the consequences of the reflective process in my practice.

This information helped me in the identification of my own values, attitudes and social interactions. The reflection about different performance

levels indicated a specific momentum as I searched for alternative hypothesis and responses. I identified the instructional strategies that would be more effective in my practice.

I used the reflective process to study the effects of my own creativity on my practice. I evaluated my openness, resistance, expressiveness, flexibility, and visualization in the context of problem solving. I used the result of this process to correct mistakes and develop new plans for my practice.

In the process of detecting consequences, I used my KMEEP model, identifying myself as a learner. This model provided for the interactions with the environment as the learning process is embedded in four major components Self-esteem, Moral-ethical, Social, and Historic-epistemological. The learning process followed a sequence of five different stages Knowledge, Memory, Experience, Evaluation, and Performance.

I used my KMEEP model to understand and describe the process of teaching and learning. I thought about my own cognitive processes. I developed new strategies for teaching. As I thought about my practice, I revised my own new strategies for teaching. As I thought about my practice, I revised my own problem-solving techniques. This process included my inductive and deductive reasoning as described in concept formation and logical organization.

One of the most important outcomes of this reflective process was evaluating my own decision-making procedures according to judgment and choices. This is reflected in the quality of my own performance in the classroom. The reflective process helped me as a science teacher in the identification of the role of my own attitudes, creativity, and reasoning in decision-making. It also helped me describe how I could enhance my performance in my practice. Finally, the reflective process was fundamental in detecting the consequences of the dual role of content knowledge and experience in the decision-making processes that affect teaching and learning.

CHAPTER 4

DATA ANALYSIS AND RESULTS

Introduction

The data analysis in this chapter includes the reflection upon excerpts of data from different sources such as the journal, the portfolio, classroom observations, peer conversations and interviews.

The journal excerpts are analyzed from the teacher point of view as I arrived to wisdom-in-practice. The principal theoretical work used in this process are Schön (1985) and Feldman (1994; 1993). Both theorists provide the conceptual framework for the further development of myself as a teacher reaching effective science pedagogy.

This dissertation encompassed three basic areas whereby wisdom-in-practice is disclosed. These areas are constructivism, multiculturalism and pedagogy. This chapter includes data analysis providing vivid examples of how to use journals, dilemma analysis, classroom observations, and conversations as a valuable tool in reflective analysis. This methodology helps the practitioner reach wisdom-in-practice.

The chapter is written with the intent of providing examples of excerpts that present information that is valid in understanding the developmental process of teaching and learning using both the phenomenological and reflective approaches.

The data analysis include the following topics as areas of reflection: constructivism, development of a system of beliefs (faith and values), fundamentalism, science education, curricular development, academic support, dilemmas between written policy and implementation, classroom management techniques, staff morale and indicators of achievement. This data analysis serves to describe the development of wisdom-in-practice of myself as a science educator.

I used my KMEEP model to describe the teaching/learning processes as I searched for effectiveness as a science educator. The study provides a written document that describes myself as a teacher in the areas of Knowledge, Memory, Experience, Evaluation and Performance.

The data analysis describes my process from novice to expert as I improved in curricular design following work with science standards and frameworks. The study describes my short term and long term experiences introducing creativity in designing new lessons. Finally the data analysis provides the opportunity to reflect upon past experiences evaluating performance and wisdom-in-practice.

Data Analysis — Research Question #1

How do I develop wisdom-in-practice and become curricular designer and negotiator using action research?

This descriptive study enabled me as the teacher to discover the relationships between the process of teaching and learning using the

phenomonological approach. I became acquainted with my own historical biographical antecedents. I also discovered my individual teaching processes in the present and reflected about experiences in my practice that helped me analyze my day-to-day teaching interactions. The study served to provide an analytical reconstruction of the classroom experiences helping in my future development as a science educator.

The documents presented are taken from the following document revisions: journals, interviews, classroom observations, reflections upon day-to-day experiences, and conversations with colleagues.

Data Summaries — Reviewing the Data Collected and Writing a Summary

In this dissertation I present excerpts of journals that provide insight and understanding of the classroom situation. I also return to the events of others examining them from different perspectives. The process was the means to observe my practice reflecting upon thinking clarifying issues. The following excerpts are presented: Reflections upon Day #1 Reflections, Journal Insight First Week, Activity and Participation in the Science Classroom, End of the Year Reflection, Constructivism Reflection (Excerpt #1, Interview #2), Development of a system of beliefs (faith and values (Excerpt #2, Interview #1), Fundamentalism (Excerpt #3, Interview #1), Typical Day of a Teacher, Science Education (Interview #3, Excerpt #1), What it is to be a Teacher (Role Modeling and Images of Joy).

Journal: Day Number 1

There is only one person in the classroom. A teacher looking to empty seats, to books and materials, to a lesson plan, to a clock that will sound loud setting a time for a process to start. In the teacher's mind the process already started. The teacher is excited, anxious to know about the new students. She is prepared, the lesson is ready together with the materials. The learning process is close to starting. The bell rings ...

The teacher's eyes are focused in the classroom entrance. There are the students, two of them seem to be arguing, pushing themselves on and off. Their voices are high. The teacher moves closer asking for answers. "Teacher, he pushed me." "I did not," said another. The teacher tells them to enter and have a seat, they will talk. The rest of the group follows the teacher and sits down.

The teacher knew that the lesson plan requires changes. Many hours of preparation inactivated by a fight; there was a need for reorganization, but she was prepared for it. She introduces herself. She asks for other students to do the same. She explains that in front of them is a name tag along with other materials. She tells the students they will do dynamics for interacting among themselves and know more about each other. She reiterates that it all starts with introducing themselves to their peers.

Voices are heard saying: "I do not want to ..." "Boring ..." "I know all of them already ..." "They come from my same school ..."

The teacher interjects that even if they know each other, and know themselves, there is always something you can say about yourself. The first student starts, introducing himself as ready to help the ladies in any way they need. Everybody laughed. The next turn was for the fighters. The first one just said his name. The second one looked to the door and said: "I don't like this class. I don't like science. I don't know why they put me here." He looked directly at the teacher, facing her saying: "Can I go to the bathroom? I'm really in a hurry, I got to go."

The telephone rings ... attendance sheets were not done yet. The teacher responds they will be there. She calls the roll, and asks for a volunteer to bring down the attendance sheet to the office as the person who collects them was not in. She was ready to continue with the dynamics process, but she realizes that there were two students out of the room, one in the bathroom, one in the office. She looks at the time, she has to wait. She reorganizes mentally her goals according to the time left.

The previous vignette shows an atypical but real situation that can happen in any school, any first day. It is necessary to assess the process identifying effective strategies and limitations of the teacher.

Strengths	Weaknesses
1. Teacher located in-site, on time	1. Teacher located not close to classroom entrance
2. Availability of Lesson Plan	2. Lack of knowledge of students coming to class
3. Availability of materials	3. Anxiety inherent to the process

This journal entry helped me to reflect about the theoretical and practical aspects of pedagogy. There are certain specific processes of interacting with students that are facilitated if proper planning and design, together with classroom management techniques are followed. The learning process does not occur in a vacuum. It happens when lesson plans are properly designed and there is adequacy of materials.

My research questions encompassed development of wisdom-in-practice. This journal entry describes a reflective approach that provided for my further development as a teacher.

Journal: Insight - First Week — September 2000

I am debating between the academic program and the number of students per class. My academic program includes four different classes plus homeroom and hall duty. I talk with some of my colleagues that are faced with problems. My peer W. was angry because he had to use R.'s classroom. R. was angry because she had to leave the room during preparation time. I became a floater, in order to accommodate the different classes. The number of students per class made a difference in the approach to accomplish the goals and objectives for each class. I focused my lessons in a student-centered approach, which includes a very individual and personal touch. It starts with getting to know my students, evaluating their previous knowledge and learning styles. It includes getting to know

their family features, goals and dreams. I know it is not the same to have 10-15 students per class as to have 25-35 per class.

Returning to the event

I remember the previous years in my practice. Every single year I was confronted with the same problem of the number of students increasing but the facilities remaining the same.

The problem of adequacy of resources is well known in the educational field. Our society has the ability to predict outcomes in the educational process. We know from statistical evaluation percentages of success in reaching high school levels. As we plan for the future we should consider those statistics.

Historical continuance of the process

I reflected on the problem as my mind acknowledges that history teaches good lessons. The problems we face now in our classrooms were the result of poor administrative decisions made in the previous years. The administrative officials fail to perceive the future. In their lack of vision they did not consider that the projections for the new school includes an increase in registration every single year for at least the next five years. I was part of the accreditation committee, and we stressed the recommendations of the accrediting commission for more and adequate science facilities. The recommendation includes science classrooms with laboratories. The recommendations were not completed complied with. The new building was

divided into facilities for the gym, pool and science classrooms on the second and third floors. Both the departmental head and the science director failed to perceive that the number of students would increase, and that the rooms could only accommodate a specific number of students. If a curriculum includes sciences classes with laboratories for each student, the problem will be there for years to come.

Reframing the situation: Activities and participation in the science classroom

Every situation I faced in the classroom is embedded with compliance with science standards. I revised the curriculum framework with every class assigned to me so the students focus on the goals and objectives of the class. At the beginning of each class, the objectives for the class are written on the board, and appear in the handouts. At the end of each section we have a summary and a brief discussion of goals and objectives. The student's assignment is written on the board together with the topics that will be considered in the next class. This provides continuity and a sense of unity with the overall standards. Every class includes different group dynamics interjecting new material and terminology in the form of games.

The revision of compliance with science standards served the purpose of periodic curricular changes addressing the specific standards. This evaluative process contributed to my further development as a science teacher. It also served the purpose of obtaining wisdom-in-practice. The

summary at the end of the class provided the connection of the previous topic with the next day of class. This only required a simple statement of the topic we covered and mentioning the next day's work together with the assignment. It provided for students the opportunity to bring their questions for clarification of specific doubts. As a teacher, reframing the situation helped me as a practitioner select the proper activities to enhance class participation.

Journal: Excerpt #3 - Group Dynamics Examples

Survivor Game #1

You are a reporter on a deserted island. Interview the person to your right. Interview the person to your left. Report to the class what information he/she shared in the interview. You survive in the game if both persons interviewed agree with your report. Select from the survivors a person to be president of the island, teacher, policeman, firefighter, hunter, doctor, engineer, dentist, planner, and politician.

Group Dynamic #2 - Individual and Collective Knowledge

Write the name of the person you trust most. Give two reasons you trust him or her. Who will you select from this group as:

1. Teacher
2. Marital Counselor
3. Economical Advisor
4. Friend to tell a secret

5. City mayor
6. Policeman
7. Fireman
8. Cruise captain
9. Priest or minister
10. Psychologist

Group Dynamic #3

Science Jeopardy

Divide the class in groups of four using numbers one to four. Design together four science questions to ask other groups. The group that answers the four questions correctly plays Final Jeopardy, selecting the category of questions to be asked.

These sets of dynamics provide an open door for a series of class interactions. First, they established an atmosphere of levels of confidence and trust between group members. It helped them to clarify goals to be attempted if they follow the proper educational pathways. It also gave me the opportunity to assess the group's previous educational background. In the first dynamic, I assessed their ability to work collaboratively as a small group. I also assessed their inner strength and ability to survive in a tense atmosphere. In the second dynamic, I assessed individual preferences and levels of trust. In the third dynamic, I obtained a sense of their previous knowledge in science using the questions they presented in their design.

The dynamics provided a cheerful atmosphere in the science classroom, and I observed that their fears were substituted by authentic sounds of joy.

Use of Journals: Revising and Reflecting the Observations of My Practice

Excerpt #12 - Implications for Teacher Education — May 2001

It is the end of the year and I'm looking at an empty classroom. The door is open as I look backwards searching for meaning in a process that started last fall. What a difference!

In the beginning the room was crowded. It was almost impossible for me to move around, to perform my tasks as a teacher, but I did it. I moved with confidence and I succeeded. In my mind are still the vivid images, my inner feelings about the inadequacy of the environment: only one door, no windows, no cabinets or anything that resembles a classroom. The past was returning to my mind as I stand in the crossroads of time in a process that begins but never ends, the educational process.

Suddenly, I have an image of myself. My heart burdened with pain, anger and frustration. The pain that inequalities cause was difficult to bear, the anger was immeasurable, the frustration unbearable. My heart was full of mixed feelings until I heard a dissonant voice: "Is this the science classroom? I hate science."

The voice was coming from the center of the room. It belonged to a girl that you wanted to stop because you knew that soon the whole

environment would change. I responded, "Yes, this is the science classroom. I think you will learn to love science."

There were smiles and strange noises in the classroom. I started the class. A petri dish was given to each student, a question asked: "Can living things live inside? Explain." Suddenly, the whole classroom was transformed, voices were heard, and beautiful eyes were wide open. The class became alive and the sonata of the learning process changed my heart of pain, anger and frustration to a melody of joy.

It is the end of the year, and I revised my work as a teacher. The year was full with outstanding results. I received many letters for above expected services. I looked back searching for the unwritten process. In every excellent process it is the steps that you follow that counts. What have I done? Did I accomplish my goals? Did my students enjoy learning science and learning in my classroom to apply science to their day-to-day life? Have I done my best? What will I change? What was left out of the process? What needs to be improved next year?

Returning to the event

It is the end of the year, and in my final assessment I felt that the job was done with excellence. I accomplished my content goals, the student developed social skills, as I contributed to values acquisition using non-standard experiences. The students were able to sharpen their scientific skills, access and establish contacts through the internet, design long term

projects, participate in field trips, redact science reviews, perform labs, establish a partnership with a nearby college, improve their academic averages, have opportunities to expand their horizons in science-based research and seeming to enjoy science as they apply to science related careers.

Historical continuance of the process

What are needed improvements for next year? I felt that next year's emphasis should be placed on unity. Why unity? Because the term encompassed the true meaning of the real work of scientists. Scientists collaborate with each other as they pursued a common goal. Teachers must work to incorporate unity in content knowledge, social and moral values, historical revisions, and visions for the future.

It is the end of the year, and I reflected on my practice. The year started with environmental problems, pregnant girls and boys in probation, intelligent students together with inclusion students. The anger, pain and frustration were not toward them. I loved my students; it is because of this love that next year I will search for more unity with them.

It is the end of the year. One of the students brought me an invitation for her wedding. The inscription read as follows: "The path that leads to happiness is so narrow that two cannot walk on it unless they become one." I reflected upon this thought as I remembered previous years. Pregnancies were rampant. At the end of the year babies coming out of wedlock were

considered by some as their diplomas, their proof of womanhood or manhood. We have come a long way departing from that path. They worked together and walked together toward excellence. The path of wisdom presupposes that I walked together with my students as their teacher, and my students walked with me as teachers. I realized that sometimes along the way, the path became so narrow that we became one. It is at that moment that teachers become learners and students become teachers. The learning process toward excellence provides for interchanges in relationships arriving to a sense of unity. This unity is based on love, trust and confidence. This unity never ends. To teach is to touch a life forever. This touch is so eternal that produces joy.

It is the end of the year. I thank God for what I am. I am a teacher. I carry the future with me.

In retrospect, this end of the year evaluation serves the purpose of a narrative on constructivsm taken from the practice. As a teacher, I observed my students construct their knowledge through a series of actions leading to sound decision-making. As a teacher, I followed their path in my own development of wisdom-in-practice. As a practitioner, wisdom-in-practice is a long trail of events that form a body of knowledge in science education. In the practice, teachers help shape changes in students' minds providing for further development in character. The path of wisdom-in-practice provides my own learning as a practitioner. I discovered that my students were

excellent teachers. They shared with me a valid and sometimes rigorous knowledge that I can use to develop further strategies for intervention in the classroom.

I. Constructivism

Excerpt #1, Interview #2

AF: What does constructivism mean? Do you have a definition for constructivism, Elizabeth?

EF: Hum. Constructivism is supposed to be a philosophy of education where the learner constructs knowledge, and for that the learner must have a specific anchor system consistent with the reality.

AF: What do you mean by that specific anchor system?

EF: You don't construct in a vacuum. I think that you construct because you have certain connections with your knowledge base.

AF: Aha.

EF: It is that interrelation of what you already have as basic knowledge, that you use to build and construct.

Reflection

This excerpt is an example of the use of the phenomenological approach to develop in-depth understanding of a concept. For me previous to the interview it was a word. This word became real and meaningful when I realized as a teacher the importance of having a philosophy of education on which we could base the teaching-learning process. This

philosophy of education presupposes that the learner is completely involved in his/her own learning process. My role as a teacher is to facilitate the learning process. This role includes providing the anchor system that is needed so the student finds meaning of new concepts in his reality. I realized that science education based in constructivism was consistent with the student reality. The student becomes the center of the educational process. At this moment the teacher becomes a facilitator of providing development areas for inquiry and critical thinking. After the interview, I made many discoveries. First, constructions must have a knowledge base content. Any building without a foundation will fall down. Second, I discovered that to educate is to help students as they construct the foundations of their own learning. This process includes facilitating making connections with their own reality. My reflection made it possible for me to realize my own learning process. I found that learning requires a knowledge-based component whereby we build and construct using previous knowledge.

Returning to the event

I reflect that we do not necessarily do this always, but sometimes we do it and we learn to construct using previous knowledge. At this moment I realized the importance of evaluations. This provides the teacher with information about individual students. The search for individuality in education presupposes a strong evaluation system of student performance.

Historical continuance of the process

The standards for science teaching are grounded in the assumptions that students' learning is greatly influence by how they are taught and that students' understandings are actively constructed through individual and social processes. The standards are also grounded upon the assumption that the actions of teachers are deeply influenced by their perceptions of science as an enterprise to be taught and learned.

NSES (1995) encourage teachers of science to understand and facilitate learning focusing and supporting inquiries while interacting with students, orchestrate discourse among students about scientific ideas, structures and facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse. The standards also encourages teachers to develop models and emphasize the skills, attitudes and values of scientific inquiry.

Olsen (1999) in his writing, "Constructivist principles of learning and teaching methods," emphasizes that constructivist learning and teaching involves focusing on the quality of students' intellectual work by promoting student higher order thinking.

Constructivist learning and teaching require minimizing the structure of student learning activities in order to recognize the student freedom in learning. To obtain their goal, teachers must develop a deep knowledge of

pedagogy to help students identify learning strategies to reach learning goals.

II. Development of a System of Beliefs (Faith and Values)

Excerpt #2, Interview #1

EF: You don't believe that atoms are real?

AF: (Pause) I think that there are scientists who would tell you that atoms are real.

EF: No, but I'm asking AF, the scientist. Do you believe that atoms exist?

AF: (Pause) Depends what you mean by belief.

Reflection

This excerpt helped me to ponder different areas in my development as a teacher. First, it helped me to reflect upon what I consider the science culture. As scientists, we based our discipline in faith in our theories, or possible explanations of our reality. We do not see atoms, but we predict their behavior and use them as we explain to students the properties of surrounding matter.

Returning to the event

As a teacher, I question the reality of the atom, but I consider the atom theory necessary to explain our reality. The question is what do I really believe? Upon reflection, I discovered that beliefs are based upon tangible experiences. By this I mean that we are participants of a culture of science and we share its values. We speak to our students and describe

processes using the scientific terminology and the theoretical frameworks we have at hand. However, it is very important that we believe in the tools of our trade when we use them as tools. In other words, if I believe that there is another possible explanation for the composition of matter, let me use it when I am teaching. If not, let me teach my students with the confidence that the atomic theory is valid for the time being explaining it.

Historical continuance of the process

The disparity between beliefs and lesson content become clear to our students as we teach. Students are developing their own system of beliefs at the same time we are teaching them. To teach effectively in science is to leave an open door for acquiring new information, for inquiring, for searching. The values of science culture can be shared but providing the flexibility to acknowledge that reality is perceived by the beholder. That reality can be perceived differently if we use different tools that are more precise and accurate.

Are atoms real? They are in a science culture that we are sharing with our students. Do we see them? No, but it is the agreement knowledge that in science culture beliefs, and works well as we explain nature. As a science teacher I feel that when I teach I believe in the methodology of science culture and I share with my students.

III. Fundamentalism

Excerpt #3, Interview #1

AF: Well, can you define it? Can I have your definition of fundamentalism?

EF: Yes. Fundamentalism is a very conservative set of beliefs and is related to Faith. I myself have beliefs that are non-negotiable. They are part of a greater structure. For example, in faith, I believe in the Divine Inspiration of the Scriptures.

AF: Wait a second. So your beliefs are non-negotiable?

EF: Uhum. I do not put my beliefs to be negotiable.

AF: Ok.

EF: Non-negotiable because I internalize them as beliefs. They are part of me.

AF: You say they are part of something larger.

EF: Yes, they are part of something larger. (Noise) For example, the Divine Inspiration of the Scriptures is part of something larger because they are part of what sustains my faith. (Pause) For me, the Bible is part of my philosophy of life and I believe in it word by word.

AF: In what?

EF: In it. That it is Divine Inspiration word by word. (Pause) That's one part of the fundamentals. Another fundamental is my belief in the person of Jesus Christ and His relationship with myself as Savior and Master, so ...

AF: Ok, you need to explain that to me ... (Laugh).

EF: Well, it is self-explanatory. I believe in God and I do believe that God is with us. I believe that God expresses Himself in His Bible to us. I believe that He sent His Son because He loves us, and for me acceptance of that reality of Jesus Christ as my Savior because He loves me even though I'm imperfect, even week, even all my characteristics. I found the relationship with God through His Son Jesus Christ. Because of love, I also believe that I'm not alone. I do believe in the work of the Holy Spirit and the Holy Spirit is in my life to sustain and work along with me. So, I see God that is personal but is one, and that has different ways, after speaking in many ways, as Hebrews says, He has spoken through His Son. His Son promised the Holy Spirit when He went into heaven. He said He would send the Holy Spirit so the three persons are working in my behalf, and they are real to me (Pause). How do you perceive that?

AF: How do I perceive ...?

EF: How do you perceive Jesus Christ?

AF: But first of all, I do not perceive Jesus Christ. I perceive Jesus, because Christ refers to the Messiah. I do not see Jesus as the Messiah. I do not use that word. I refer to Jesus, the man and maybe Jesus the Prophet.

EF: Do you believe in Jesus as God?

AF: No ... no.

EF: You still waiting for the Messiah then?

AF: I don't know if I'm still waiting for the Messiah. That part are aspects of the Jewish religion that the Messiah has not come (Pause).

EF: You believe that?

AF: That the Messiah has not come? Oh, I strongly believe that the Messiah has not come.

EF: So you are waiting for Him?

AF: Well, just because I believe that the Messiah has not come doesn't mean I'm waiting for the Messiah. I could believe that gold coins are falling from the sky, but I'm not sitting around waiting for gold coins to fall from the sky. So just because I think something doesn't happen does not mean I'm waiting for it to happen. No, no.

EF: So you believe or not the revelation of the Bible in the Pentateuch? What I mean is, what is your perception of the Bible, of your Bible?

AF: I like to believe that there is some truth to it (Laughs).

Reflection

This reflection addresses the issue of being a woman of faith and a woman of science. How do I interrelate both worlds? How do I address the controversial issues that derive from being a scientist and a teacher? The answers to these questions are written in my development of wisdom-in-practice.

Returning to the event

As a woman of faith I do not negotiate beliefs and values. As a woman of science I find means of conveying both worlds for the sake of my students' learning process. I find ways to expose my students to controversial issues helping to enhance their learning. I guide them through the avenues of reflection searching for answers. I came to realize that in my own learning process faith becomes an important part of me. I am surrounded by biblical concepts. I believe that we can teach the Biblical account of the Creation without endangering the students' learning process. The logic of creationism is part of their reality.

Historical continuance of the process

I do not have to erase their Christian perceptions to impose evolutionary ideas. I expose my students to both worlds, knowing they can find anchors in their own beliefs. I believe in Jesus Christ but I do not impose my beliefs on them. A great part of being a scientist is the practice of science. Giving possible explanations to the observable world. To be a scientist is to search for meaning in the reality of the world. For that type of research we need faith, we need beliefs. In the same manner we use the atomic theory, without being able to see the atom, we can express our existence as we teach in a world surrounded by faith and beliefs

I reflected upon the interview as my professor acknowledged his disbeliefs. He does not believe in Jesus as the Messiah. Being a Jew, his

faith is based upon other beliefs. His acknowledgement of this during the interview serves the purpose to make clear in my mind as a student that he has a different set of values. This difference in values does not diminish his ability to be a physicist. My belief in Christ, being just the opposite of his values, does not diminish my ability to be a scientist. To my knowledge, faith and believes enhance our perception of the world. It was in this moment that I found the fine thread between being a woman of faith and a woman of science. I know that I believe in God as the Creator of a vast universe. I also know that science is the means God used to describe His world to me. I remember the words of wisdom of the Book of Proverbs 3:19-20: "The Lord by wisdom hath founded the earth, by understanding hath He established the heavens. By His knowledge the depths are broken up, and the clouds drop down the dew."

Reflection VII

AF: Tell me about your typical day as a teacher.

EF: A typical day — I wake up at 6 o'clock in the morning. I pray. I go to the bathroom and take care of myself. The previous night I have checked everything that I need. If I need something to do, I have a good idea in the morning about what to do. I do not like to rush. I like to be in my room waiting for my students having the lesson in my mind. I like to have organized what I am going to be teaching, this includes goals and objectives, the purpose of my lessons. I tried to be organized with my lesson plan. I

like to check that the environment is adequate. I also check that I have enough materials. I like to check that the environment is comfortable and adequate in case I need to change settings or move around. I even think about things that could go wrong. I prepared for those in my planning. I like to be prepared for any "imprevistos," things that are unexpected and happen in the scenario.

Reflection

Teachers must maintain a solid spiritual life that sustains them and provides support in the midst of crisis. Prayer and planning together are a great combination for a successful balance enacting proper actions. Prayer sustains the line when planning does not succeed. Both work together as teachers organize goals and objectives in their practice. I never realized how they work together until a crisis happened. Plan for the real, prepare for the unexpected.

The development of wisdom-in-practice in my case is surrounded by a strong foundation in spiritual beliefs. I am a science teacher but also a woman of faith. I perceive teaching as a ministry. Teachers are responsible for enhancing the educational processes of a very diverse population. Each individual in our classroom requires special and often delicate handling. As a practitioner I only have one single opportunity to accomplish my goal, the year in which that student is assigned to my classroom. If my curricula design provided for further development, I accomplished my goal. If not, I

would not have another opportunity in time. Dealing with time constraints required me to touch eternity, and when we confront eternity we need prayer.

IV. Science Education

Interview #3, Excerpt #1

AF: This is February 19. I have in front of me the proposal that we work for the AERA conference. In the proposal we respond to the committee challenge which is to consider the challenges and opportunities that we faced in areas such as epistemology, pluralism, and reform by looking at the intersections of faith, fundamentalism, and constructivism (Pause). One of the things we haven't talked about seems to be the political issue; what is taught in schools and how it is taught. The big fuss seems to be the teaching of evolution in schools. I know you are a biology teacher. Do you teach evolution?

EF: Yes, I do (Pause).

AF: How do you teach it? I mean do you see any conflict between teaching evolution and your beliefs in the Bible as revealing truth?

EF: I do believe that the purpose of education is to produce an integral human being, and for that you have to be exposed to a broad amount of theories, thoughts, and ways of thinking. A teacher should not hide from the students what is a theory or a possible explanation. It would enhance the process of the student search as he looks for the truth by himself

constructing his own knowledge. So the way I teach evolution is in a way of exposing them, that there are traditional explanations, that the search is still incomplete and it is not according to all people's beliefs, but it is there. They have to use critical thinking, inquiry, and try to search for themselves the truth of evolution. On the other hand, I also expose them to creationism and Biblical accounts. I do not see any conflict in that. The search for science and faith do not have to be a major fuss.

AF: What about the arguments that science should be taught in science classes and religion should be taught in religion classes?

EF: That's the same argument that there is in the country about the integration of religion in secular matters. I do believe they are making a disservice to the students when we are not using the hand that is provided by faith so they can deal in the world with it.

AF: Well, I do not see how the students would say, teacher, I do not believe this because I was taught this in the church.

EF: My purpose as a teacher is not to make them believe one way or the other. My purpose as a teacher is to expose them to the reality of theories that help them as they inquire about science and faith and make their own decisions.

I perceived my role as a teacher or a facilitator because I deeply believe in the human capacity to think, create, and perform. I always tell my students that if God wanted us to all think alike, He would have created only

one brain. He did not. He created each individual with the ability to develop their own and unique thinking process. As a teacher, my commitment is to open avenues of interaction for further development of knowledge. I believe that every single student can and will learn at their own individual pace and level. Our own intellectual process requires a proper construction of content knowledge with environmental processes.

Conversations with the Self:

Narrative of Interaction Between Theory and Practice

In the previous chapter, using the theoretical framework of Schön (1985) and Feldman (1994; 1993), I identified the phases of the reflection on action. This narrative of interaction between theory and practice includes the reflective approach. In this approach I reframe the situation, experiment with the situation through conversation, and detect consequences. The validity of conversing with myself and others helps my formation as a wise practitioner. Wisdom-in-practice relies on the accumulation of proven knowledge establishing ownership and identity during the process. I found my sense of identity and I write addressing my arrival at this stage. Using both approaches, the phenomenological and reflective approach, the "I" surfaces from the "we." I presented my own peculiarities as I discovered my tangencies with other teachers. When I reached this moment, I felt connected to the road of teaching paved by theorists and practitioners of the science and art of pedagogy.

Conversations with the Self:

The Present

Reflection VI

"I am a teacher ... and I carry the present with me."

EFC

"The basis of the perspective from which teaching is viewed as a way of being begins with the recognition that teachers are people in the role of teacher, who act as teachers, and teach in educational situations."

Allan Feldman (1997)

I. The Teacher

What is it like to be a teacher?

What are the concomitant factors associated with effective teaching?

Is there a magical formula for becoming a teacher?

Can we teach others to become effective teachers?

Can we learn how to excel in the classroom as teachers?

The answers to these questions lies deep within the teacher as he/she reflects in their practice. The educational framework that sustains and nourishes the students, together with the concomitant factors associated with teaching provides for answers.

"There is more going on in teaching that can be made explicit, which is the wisdom-in-practice that comes about through teachers as human

beings, interacting within educational situations with other entities, both animate and inanimate, and especially, other persons" (Feldman, 1997, p.).

I. The Teacher

The teaching area is a field where we find much diversity. It is a mixed sample of different personalities, genders, races, creeds, and qualifications. It is within this diversity that we have to identify the uniqueness of ourselves as teachers. It is there where we find what it is to be a teacher.

Teachers are not born, they are created by a process of interaction between themselves and their environment. They are formed and shaped within a society that gives origin to unique masterpieces. Each teacher's uniqueness is tested and re-created in interaction with the students and the environment where they served. It is for that reason that they are partakers of wisdom-in-practice.

To be a teacher one must grasp our own identity, know ourselves, participating in the sweet nectar of the art, and in the exciting experience of the practice. To become a teacher, you must look within yourself, know who you are, including your greatest talents, but also your shortcomings and overall limitations. You must find the connection with the art of teaching, and the science of practicing that art. It is then that you find fulfillment in the art, enjoying the beauty of what teachers do: we teach. You must find the strength of performing a practice, the science of teaching itself. To

become a teacher, I must know myself, the "I," but I must also know the "We." The process requires knowledge of myself as a human being, but it also requires knowledge of the subject, the students, and the environmental universe associated with teaching.

I, the teacher, perceive the world through memories and experiences. It is through the memories in my brain that I carry my baggage. I find the tangencies between me and the world. I have become sensitive to basic human needs. I share this sensitivity with my students as the educational arena provides for such interactions. I have been shaped by centuries of wisdom-in-practice. I am a creation of past memories and present actions. I am aware that memories alone do not create teachers. It is necessary to the practice, the experiences that shape and mold identity.

I need to reflect upon my teaching strategies constantly, revising techniques, procedures, methodologies. It is through this constant reflective process that I become a teacher, linking theory with practice. This evaluative interactive process provides for bridging the gap between the art and the science of teaching. I balance myself in proper interaction with the educational environment.

I, the teacher, become formed in the deepest currents of knowledge, but shape and mold in the strong fires of practice. My identity is created in these strong currents of knowledge and practice savvy that produces a learning process again and again.

I, the teacher ...

I am with myself, but not alone. I am surrounded by a multitude of beings that like myself participate both from theory and practice. I come alive in a complex milieu, surrounded by teachers, learners, parents, administrators, communities, cities, nations. It is this world that delimits and strengthens my actions and regulates my performance.

Yes, I am a teacher ...

But deep within me I know that I exist as a being, and that understanding myself together with the concomitant factors associated with learning and teaching provides for excelling to my highest possibilities. I am on my way to success. I am able to be the artist and the scientist. I am a human being called a teacher, being proud of it. I, the teacher ... carry the future with me.

V. The Present

Interview II, Excerpt #6

AF: Tell me, what is it like for you to be a teacher?

EF: It is difficult for me to be concrete in what it is like to be a teacher. It is an experience, one that you work out day by day. There are some important aspects in being a teacher. I believe that a teacher must know the content, or subject matter. I believe that a teacher must have a meaningful relationship with his/her students. A teacher should establish a rapport with the students as he works daily with them.

Reflection

Experiences are a continuum for both teachers and students. Every single experience in the classroom is surrounded by content knowledge. Teachers must grasp their subject content in order to facilitate learning experiences that are meaningful. Knowledge is provided freely as teachers effectively try to establish relationships with their students. Knowledge acquisition becomes a bridge interconnecting teachers and learners. The richness of experiences provide for establishing daily relationships as teachers become learners and vice versa.

As I reflected on this topic of teacher identity as it relates to knowledge (content), I had to look back to the theoretical framework. Using action research I discovered the validity of my practice strategies framed on a valid theoretical framework. I became acquainted with Piaget's results reaching how people acquire knowledge. Piaget's concept of knowledge includes physical knowledge, discovery; logical-mathematical, invention; and social, arbitrary knowledge. He provided for a developmental theory of knowledge.

In science education, teachers must facilitate the physical knowledge acquisition through discovery techniques that are aligned with the subject that is being taught. They also should facilitate logical-mathematical content by means of encouraging inventions. Finally as a science teacher I encourage the social development of my students until the manifestation of

what Piaget called arbitrary knowledge. This includes knowledge of rules, laws, morals, values, ethics, and language system. This knowledge evolves within cultures. In my science classroom, students participate not only in the Hispanic or Anglo-Saxon cultures but they have to be exposed to the existence of a science itself. They have to develop science terminology together with the acquisition of science investigative techniques.

Conversations with the Self:

Interactions with the Past

Reflection I

"The past is a great place to visit,

but not to stay there."

"Lend me the strong stone of the past,

and I lend you, alas, the wings of the future."

Robinson Jeffers (1920)

VI. The Past

Interview I, Excerpt #1

AF: So, let's see. What things from your past do you consider decisive in your decision to become a teacher?

EF: My father was a great role model. He was very successful in his short life. He died when he was forty. During his short life, he built two churches, did great work for his community, and was a great teacher. Many of the things that I read in books today about teaching, my father has done. He was very advanced in his teaching practice and thinking, plus he was a great human being. So to put it together, I always believed that teaching is the greatest and the most rewarding profession because of what I saw in my father. I believe that when you become a teacher, it is for an eternity, you don't stop. The lessons don't stop, your contributions go on and on.

Reflection

To become a teacher is to grasp an identity. Such an identity permeates your innermost being as you perform your day-to-day routine until it becomes a philosophy that enriches your life and your practice. A great decision on becoming a teacher relies on the identification of who your role model is as a practitioner. Your practice gains a different meaning when you emulate someone you learn to love and admire. You focus your practice in the proper perspective. You acquire a global view. You acknowledge that the lesson plan does not end at the classroom. It goes to the world that sees a product seeing your commitment and dedication as a teacher.

As you develop wisdom-in-practice you begin to see yourself not isolated in a science classroom. You begin to see yourself as part of a world full of practitioners from different countries and historical eras. Your

teaching acquires another dimension as you see yourself in the context of your students' experiences within the world we are all living in. Your development as a practitioner results in the influence you produce that motivates changes in the world. So you send your students with the hope that using their acquired knowledge they become agents of change. Every year you find that they return with small and great achievements. You realize that the grains of sand produced in them produce great pearls. As teachers part of our wisdom development is to acknowledge that even though not all our students succeed from the global point of view, the educational process of learning is started and will never end until your students expire.

B) Critical Notes

Altrichser et al. (1993) urge us to move beyond the details of events to a conceptual level.

The revision of my critical notes led me toward a conceptual level of thinking. Feldman (1997) presents the teacher as a wiser practitioner, one who draws upon and adds to a wide set of knowledge, can use that knowledge and professional experience to deliberate about and reflect on practice, acting wisely within educational situations.

There are four major outcomes from moving beyond events to a conceptual level. First, the process helped me as a teacher to develop a sense of identity. I acquired knowledge of my importance as a teacher,

about the importance of the discipline I teach, and about the concomitant factors in teaching. Knowledge, for the purpose of this dissertation is defined as application of facts and ideas acquired by study, investigation, observation, or experience. I acquired knowledge of the value of my practice experiences in reaching my goals and objectives as a teacher. I evaluated my strategies interconnecting the value of content knowledge and memory with experience. I revisited the work of theorists such as Piaget (1936; 1937; 1946) and Dewey (1929), and applied their findings to my classroom. I became acquainted with the value of observation writing my pilot study cases. My content knowledge was revisited as I re-evaluated my class curriculum.

Second, the process helped me in identifying my own sense of values as I clearly identify the moral component in my practice. This process helps me to revisit Kohlberg's (1985) work, and redesign tools for incorporating values in my teaching. I became aware of the importance of my values, and that they were not in conflict with the teaching arena.

Third, I developed a sense of interactions and relationships and their importance in education. This development of a social component reached high in my performance stressing the role of environment as it is reflected in the practice. Finally, I reached the high evolution of educational joy, the inherent quality of great performances. I moved beyond mere theories to a sound practice not designed by others but by myself. The events of my

practice were ordered together to produce a lovely melody in my performance. I enjoy what I do, and as a teacher I look forward to the future with confidence.

The use of critical notes is a useful tool to explain how and why events occur. Through a series of observations of my classroom, I became aware of the processes of teaching and learning. I discovered that students use knowledge to construct knowledge, but this knowledge has to be in their own memory. This helped me in the process of conceptualization of how the learning process occurs. The use of my own critical notes helped me in the definition of other important concepts. This discovery enhanced my development as a science teacher. The classroom was the center for my students to experience and evaluate their knowledge in order to adequately perform. As a teacher my role constitutes being a facilitator of their own learning experience. The final outcome of their learning process will be performance, or their ability to accomplish an action. I discover through my analysis that if we stop the learning process in evaluation, we are incomplete.

C) Shaping Metaphors

As I used metaphors, I was able to transfer meaning from one field of experience is often a colorful one to another often an abstract one.

This process provides an example of transferring from the field of physics to the educational field using the metaphor of the reflective mirror.

The use of metaphors has been widely recognized by action researchers for its value helping analyze the process of action research. As I used the metaphor it helped me stimulate new directions in my developmental process.

D) Pattern Analysis

Regularities as forms of interaction which occur over and over again (Weland & Russell, 1978). I used problem analysis interpreting data inquiring about the nature of teaching and learning. I used problem analysis identifying rooted attitudes which are keys to a better understanding of teaching. The problem analysis was fundamental as I contrasted annual revision as related to curricular revision. This analysis introduced new strategies in the practice to improve teaching and learning.

In this dissertation I used pattern analysis using both approaches to research, the phenomenological approach and the reflective approach. The first approach helped me identify the procedural steps in arriving at wisdom-in-practice. It was using this approach that I found the concomitant factors in my teaching career as I become a wise practitioner. I discovered my identity together with my deepest beliefs and value system.

Pattern analysis helped to use the reflective approach to properly identify forms of interactions that occur over and over again in my science classroom. This reflective approach provided for identification of the

learning patterns through observation of the multiplicity of class interactions and relationships.

It was through the interactions of both the phenomenological and reflective approaches that my constructivist learning process occurred as I developed what further became my anchor system. I discovered that I as a teacher have specific motivational incentives. My personal motivation was upon the firm belief that every student should be respected as a learner in the science classroom. I also reaffirmed my belief in the value of lesson planning, providing an adequate and intensive environmental climate for learning.

Pattern analysis included the regularity of yearly curricular revisions that included both the content knowledge and the theoretical frameworks. This analysis reaffirmed the use of both collaborative and cooperative learning in the science classroom opening avenues for communication in the multiple participants of the learning process in my classroom.

D) Dilemma Analysis

Facing dilemmas that require professional decision-making (Winter, 1983).

As I worked on dilemmas, I tried to solve them if possible. I also tried to identify and value minority views on teaching and learning processes.

One example of dilemma analysis that requires professional decision-making every year is certification for graduation for the students. Every year

as a teacher I am required to sign completion documents for my students. It is required that each student fully comply with the requirements of the school to obtain his/her diploma. As a teacher and learner, I was confronted with the importance of this process through my own graduation. In order to use the cap and gown I will have to fulfill the University requirements for graduation. On many occasions parents and administrators tried to press the teachers in certifying that athletes fully complied with the standards. Every year I feel satisfied that I do not yield to pressure of outsiders. In my science classroom students have to fully comply with the requirements in order to obtain a grade and authorization for graduation.

Outcomes of the Reflective Approach to Pedagogy

The most valuable outcome from this approach is that I developed a sense of identity with my practice through a reflective process. Using this methodology I was able to identify the theoretical framework that sustained my practice. I was able to identify and reproduce the learning process explaining the procedural steps using the KMEEP Model. I was able to identify the concomitant factors for developing wisdom-in-practice. I was able to establish the link that interconnects theory with practice establishing his own teacher anchor system.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS OF THE STUDY

This dissertation addressed the following questions: How do I develop wisdom-in-practice and become a curricula designer and negotiator using action research? and how do I use wisdom-in-practice to teach in the multicultural science classroom?

The process of development of wisdom-in-practice presupposed in my particular case a journey from the historical perspective. It included the revision of major theorists in the educational field such as Piaget, Dewey, Schöm, and Feldman together with up to a hundred other theorists. I also included my reflection about my practice addressing the needs of my students and my inner motivational goals. In this journey I found a pattern of modeling through the written history of former educators who, like myself, believe in the educational process.

I have presented in this dissertation my struggle to construct my own strategies of intervention as I dealt with day-to-day decisions. I found myself in a constant process of evaluation and reflection.

This dissertation is a descriptive study. According to Borg and Gall (1994), "descriptive studies have increased our knowledge about what happens in schools" (p. 81). This study includes the use of the phenomenological and reflective approaches to pedagogy.

How Do I Become A Wise Practitioner Using Action Research?

This dissertation study centers around the art and science of the profession of teaching called pedagogy. It intends to recollect the knowledge and development that resulted from an educational process that occurred in myself as a science educator. The study is descriptive in nature, as I developed wisdom-in-practice.

As a teacher I acknowledge that action research is a powerful strategy for professional development. Action research provides the adequate techniques to observe carefully, reflect systematically, and use my observations and reflections to improve my teaching.

What I Did Not Know

As I started using action research, I did not know about constructivism. I did not know that the basic constructivism assumption established the multiple perspectives from which individuals view the world. This basic assumptions provides for the entire shape of education whereby individuals develop views of the world by constructing internal mental models. This view was in contrast with the objective assumption that knowledge/truth exists beyond the mind and therefore was "objective." I did not know that educational institutions by and large, operate on a philosophical base shaped by objectivism.

I did not know that according to objectivism, learners are told about the world and expertise to replicate both content and structure in their

thinking. The objectivistic assumption implies that learning is viewed as more than the knowledge base of experts. Students learn according to the view acquiring the same knowledge as the teacher.

Constructivism, on the other hand, emphasizes individual performance, curricula based on clearly defined disciplines. It emphasizes competency testing, grading procedures, and placement testing. Constructivism implies the development of learning environments, engaging students in authentic tasks, assisting students with producing knowledge bases that promote the application of information and diversity of thought.

I did not know how I could apply this constructivistic view to secure eduction. I did not know to trace the origins of theoretical frameworks to diverse landmarks well known in the educational field.

What I Know Now, That I Did Not Know Then?

I know the value of tradition. I learned that modern theories and historical philosophers demonstrated that education is rooted in diverse educational traditions emphasizing development, experience and values acquisition. I arrived at the importance of theory for an effective practice.

As I did the pilot study prior to this dissertation, I became aware that science education could benefit from the findings that researchers such as Piaget, Dewey, Schön, and Feldman found. I also became aware that the practice in my classroom could provide evidence that diverse educational goals were attained.

I discovered that learning environments should provide a sense of security, identity, and sense of belonging and purpose in order to develop a high component of self-esteem in the learner. I called this Component A (Self-esteem). I even found a theoretical framework for it in the work of Seaberg (1997).

I also found the importance of properly identifying the different levels of learning styles prior to engage in a learning adventure. The work of Myers & Briggs (1970) and Horton and Oakland (1998) provide for the theoretical framework in this endeavor. The levels classified as extrovert/introvert, practical/imaginative, thinking/feeling, organized/flexible could provide for Kersion Combinations and Sixteen Styles Combinations that could be applied to the classroom (Myers & Briggs, 1970).

I know now about the importance of providing a moral-ethical component to the learning process. Using Kohlberg's (1985) work from Level I Obedience/Punish oriented, Level I Egotistic oriented, Level III Post Conventional, Level IV Values Interaction, Level V Ownership of Values, I arrived at a Level VI Performance according to values.

I discovered the value of identifying the concomitant factors that affect learning. Upon reflection on educational thinking, I identified the existence of varieties of wisdom-in-practice. Every generation has produced theorists that identify the gap existing between theory and practice, and thereby bridge the gap.

The shoulders of greats such as Plato, Aristotle, Piaget, Bauber, Dewey, Feldman, Heidigger, Schön, Skinner, and the majestical coterie of the of the colossus of all educators, Jesus Christ, represent the development of the educational process.

I know now that students' learning is based upon teachers' application of educational theories in their practice. I discovered that the learning process includes the following components knowledge, memory, experience, evaluation, and performance. The learning process occurs surrounded by a self-esteem, moral-ethical, social, and historic-epistemological atmosphere.

Science education consists of concepts and relationships abstracted from the classroom practices. I became a wiser practitioner identifying the theoretical framework that explains the science educational process. I acknowledge that the constructivistic learning process provides for students constructing their own ways of knowing as they continue to be performing within a world of their personal experience. The quality of their own constructions describe a microculture that exists in the practice able to coordinate these individual activities. Using action research in my practice, I was given the opportunity to obtain unanticipated teaching outcomes.

I know now that pedagogy, the art and science or profession of teaching is deeply linked to epistemology, the study of a theory of the nature and grounds of knowledge with reference to its limits and validity.

I discovered that for a teacher to develop a learning theory, he or she needs to gain knowledge or understanding of a skill by study, construction, or experience.

I am conscious now that learning is an art or experience of the me who learns. These experiences enable the learner to produce new constructs as he/she applies internal responses.

Strategies for Linking Theory and Practice

As I did my course work, wrote my comprehensive papers, did my pilot study, wrote this dissertation, and was a teacher, I developed and used the following teaching strategies:

1. Memorization & Recitation (Memorizacion & Recitación)

This strategy addresses the knowledge component dealing with the learner's ability to develop a science vocabulary. The learner identified new vocabulary meanings in order to obtain content mastery. The recitation progress helps it try to be gender neutral to interrelate day-to-day happenings with scientific knowledge.

2. Rhetorical Questions (Preguntas de Retórica)

This strategy is sued to enhance creativity presenting unresolved questions promoting both individual and collaborative participation. The strategy addresses the historic-epistemologic component helping the student to research trying to find answers and compare findings with historical researchers of similar topics.

3. Collaborative Learning (Aprendizaje colaborativo)

This strategy is used to promote collaborative participation, helping the students use the strength of the group to find solutions. The form used in this collaborative approach consists of dividing the group into small sections consisting of four students. A research reading is provided with the final goal of a class presentation. The group is responsible for studying the article, read, and bring an open discussion to the class focusing on the main issues covered in the article. At the end of each section there is an open-ended question discussion. The critical thinking component of the science learner is enhanced together with the further development of research skills, helping in the development of an investigative mind.

4. Research and Investigation (Investigación)

The students are provided with a vast list of research topics from which they select one using it for further investigation. The topic lists are derived from current science literature associated with class content. A guide for the monography format is provided together with a section of visits to the library. The teacher has previously summarized the collection content revising the material available for each topic. In a joint section, after the students have selected the topics, a final visit to the library is done searching for additional material. The results are monographs that are done following a research pattern that is interesting for students because they have ownership of the topic selection.

5. Audiovisual Technology (Videos, Movies, Demonstrations)

The audiovisual component in science is responsible for at least 97% of content mastery. The students need to interact the factual content with visual perceptions in order to grasp the meaning and activate the memory level needed for adequate performance. The vast variety of audiovisual material available makes it possible for the responsible teacher to select the ones that interrelate content with visuals making the class interesting and appealing for students. The excuse of money limitations can be overcome by creativity. It is up to the teacher to develop the audiovisuals he or she needs to provide the quality of presentation each student deserves. The students can be participants in the selection of adequate audiovisual material since we have identified their learning styles previously.

6. Simplification Versus Complexity (De lo simple a lo complejo)

Complexity Versus Simplification (De lo complejo a lo simple)

Science is a field so rich that teachers can search within the content for strategies to enhance learning. The teacher can escalate steps of in-depth knowledge from the simple aspects of life building up for more complex ones. The decision is based upon learning styles and individual models. A matter considered simple for one student can indeed be very complex to another. Therefore, the teacher should use individuality as a measure or standard for presenting content. The teacher becomes a learner,

the students become a teacher, and it is in this dichotomy that the learning process occurs effectively.

7. Interpersonal Grouping (Trabajo Colaborativo Grupal)

The teacher can enhance learning using the strength of the interpersonal relationships of the group. Once the classroom atmosphere is established, the students feel comfortable to select their partners from the group. The strength of this strategy relies on the individuality of students' learning process and social interaction skills. The teacher should provide an effective interaction that goes from joke sharing, birthday celebration, to expert content identification. The interpersonal grouping is not for learning in its inception, it is for sharing. It becomes a learning device once the goal of sharing is fulfilled. The purpose of intergrouping is to enhance the self-esteem of each individual student. Each of them has the right to select his/her peer to laugh with and enjoy, each one has the right to divide time effectively, each and every one has the right to work if they want to, and each and every one has the right to be themselves. The classroom does not become a circus whereby each animal performs, it becomes a harbor where each individual feels at home.

8. Mathematical Calculations Strategy

Each science student needs to address the fear of the mathematical component related to the specific science being studied. This strategy serves as an equalizer for the learner once limitations in math are overcome,

or once the math component is strengthened and it is used as a tool. The strategy is used in the identification of strengths, and weaknesses have been overcome, to strengthen the confidence that finally the monsters have been mastered.

9. Game Strategy (Estrategia de Juegos)

A basic foundation in science must be that science learning is fun, is enjoyable. The learning process of each student must be creative and covered with joy and happiness. The learners need to feel that the classroom sometimes becomes a basketball court or a boxing ring without fights. The teacher will encourage competition between teams as they answer questions, resolve situations, or overcome competition. The end result is content mastery, knowledge learning in such a creative way that it guarantees success and desire to further learning.

10. Literary Analysis (Small Group/Individual/Large Group) (Analisis Literario)

Science is based in historical discoveries, small links of contribution to the further advancement of science. A lot of scientific material needs to be taken from the cemetery of history and made vivid to the student in order to trace the historical grounds of scientific discovery. In the literary analysis strategy the students become participants of the historical search for truth. It starts from a small group, each individual becomes a scientist, and finishes with a large group presentation. An example of this strategy is the

development of the Structure of the Atom passing from the Greeks, Dalton, Rutherford, Bohr, until reaching the charge cloud model. The literary analysis permits the learner to explore the historical content of science searching for answers.

11. Individual Collaborative (Collaborative Individual) (Trabajo/Individual Colaborativo)

This strategy helps to identify and focus on student styles that can be learned. The majority of students benefit from it due to the spontaneity of it. The students search collaboration tasks that they do not know s it is adequate to use this approach in learning difficult concepts. It differs from collaborative learning in that ownership of the procedure belongs to the students. Once the students have initiated the process, it is time to use strategy. Coping is one of the most effective student styles. It has been used for centuries, passing on information in cases with misconceptions. It is better to let the procedure be used for student benefit using students as sources of knowledge from peers.

12. Ownership of Concepts (Dominio de Conceptos)

This strategy helps to increase the self-esteem component in the learning process. Each individual has a specific way to grasp, understand, and explain concepts. This process is bypassed for the sake of the group, but constitutes strength to be used in the classroom. The identification of the learning styles provides for a variety of demonstrations whereby

students present their own concepts. This can be used for concept acquisition and revision.

13. Class Demonstrations (Demostraciones)

The learning process occurs between the idea presentation and the demonstration of such ideas, as much as we can, in the practice. This strategy provides for the scenario where theories and practice come together. Nothing overcomes the value in science for class demonstration of how an event happens. Examples that are vivid such as circulation in animal heart, volcano explosions, chemistry reactions, plant identifications will always be stimuli that enhances learning.

14. Individual Presentations (Presentaciones Individuales)

This strategy is used in order to never underestimate the value of the individual in science acquisition process. Once a student is encouraged showing his/her learning in a specific topic, the overall learning process acquires a new dimension. In teaching, never underestimate the individual value of the student as presenter of his/her view. This could be a major contribution to the learning process because it contains the individual's perspective to content knowledge.

15. Lectures (Conferencias)

The value of this strategy relies in the expertise of the teacher in his/her subject. The lecture serves to develop anchoring systems providing the ground for further development in content mastery and critical thinking

styles. No lecture is exhaustive, therefore, the use of open-ended questions would lead the way for further insight and continuous search for truth. The teacher should evaluate the process of interaction with the students through lectures, presentations, and incorporate material appealing to each individual learning process. The utilization of a card annotation for each student will be helpful in lecture preparation and presentations. The lecture strategy is valuable when used with individual interactions for clarification and in-depth explanations according to each individual level. Lectures should be clear, concise, and according to the time span for an average group.

16. Discussion (Discusion)

This strategy provides for the development of an anchoring system that provides the specific framework of the learning process. The discussion process should be based on the individual needs of the students. It should not be forced, but occur spontaneously derived from students' needs. It is up to the teacher to provide the adequate arena for topic clarification and interaction. The process of discussion should be monitored to see if it has been effective. In case of further exploration time needed, arrangements should be made in order to accomplish the specific objectives.

17. Testing and Examinations (Quiz, Pre-Test, Post-Test) (Examenes, Pre-prueba Post-Prueba)

Testing is another strategy to enhance learning. It is from testing that adjustments could be made, new trends could be developed, and revisions

could be made in order to obtain better results. Testing should not function in a vacuum. It should be part of adequate planning, following the proper curriculum development process, something that students enjoy and expect. The development of tests should provide grounds to verify individual accomplishments in order to follow the proper path for each individual learning process. Testing could be oral, written, computerized, or through active interaction. The purpose is the same, to obtain a proper idea of where the student is in his/her individual process, and how the teach can help reach objectives.

18. Parental Interactions (Interacciones con los Padres)

The strategy of parental interaction is very effective because parents are an essential part of the individual student's learning process. They should not be excluded from it, and their interaction is valuable in the student obtaining individual goals and objectives. A proper parental interaction should be something each individual teacher should create to be used for the benefit of the overall individual learning process. Once the parental network is established, it functions as glue to integrate/augment each building block in the learning process. Their accomplishments are a reason for parents' involvement in the school process and in school success. The establishment of a parental network requires time, but once established, the whole community is a beneficiary because it is through participation effort that a student is educated. The parents are a fundamental part of the

learning process. They should be cornerstones in the advancement of knowledge mastery, skill development, and values fixation.

19. Counseling & Administrative Intervention (Consejeria & Intervencion Administrativa)

The counseling and administrative offices are fundamental in the learning process. They provide the foundation for proper behavior and social functioning within a school which provides for the socialization of individuals. The science teacher should construct a proper network of interaction with the social component of each learner. These offices have been used as disciplinary sections in the learning process, but should be reused as concomitant factors in learning science. These offices should participate in student accomplishments and in student evaluations. They should also be participants in the historic epistemology component of science and as reservoirs of scientific methodology in learning.

20. Independent Study (Estudio Independiente)

The independent study serves a dual purpose both for the advanced student and limited one. The independent study requires the consistent effort of the student learner plus the dedicated interaction with the teacher. The ball is in the learner's court as he/she searches for further development in the learning process. The strength of this strategy is corrective in nature, providing factual confrontation and insight development of the critical

thinking mind. The process provides for a continuum search for truth and creates the momentum for discoveries.

21. Contracts (Contratos)

The student construct of knowledge requires the development of individual responsibility in accomplishing tasks and requirements within a framework of time. The advantage of this strategy is that it is written in a language understood by both parties. The contract helps create a conciseness of the learning process. It begins with the contractual agreements and ends with the result of such endeavor. The contract provides for changes and flexible arrangements along the way. Since it is based in time it helps both the student and the teacher to be efficient in tasks and accomplishments. The contract is a work document, a tool that can be used to focus on goals and objectives. The short-term goal is the road for long-term goals, as the staircase of learning proceeds.

22. Tutoring (After & Inside School) (Tutorias)

This strategy requires individuals willing to accept the challenge to use their strengths to benefit others' learning process. The value of individual tutors is extraordinary. The process of selecting and implementing a tutoring program helps the teacher evaluate and re-evaluate students according to strengths and weaknesses, together with learning styles. Once this step is finished, the program will provide for every single learning objective to be mastered and every single goal accomplished.

23. Library Network (Red Bibliotecaria)

The library is inside the school as a perfection device. It provides expertise and knowledge in nutshells, volumes, or computerized services. This strategy expands the classroom world, enhances concept mastery, helps to develop skills, factual knowledge, and critical thinking. It helps build creativity together with cohesiveness in conceptualizations. The library network must be accessible to every single classroom as a top view insight to the world of knowledge.

24. Rewards (Individual & Collective) (Recompensa Individual/Colectiva)

This strategy serves as the carrot in the learning process. Individual or collective rewards constitute the basis for motivation. Once the learner is motivated, the reward is not important, the work is performed for the sake of satisfaction, however, to initiate the process it is much needed. The teacher's insight to the learner's processing indicates when, where, and what will constitute rewards since they are different for each individual or group. Rewards are objects of desire for the mind and cannot be ignored in the learning process. Rewards should not be overused nor imposed, they should come freely as needed, and once the goal is accomplished, should disappear without a trace until a new moment generates its return.

25. Creative Display (Exposicions Creativas)

A display serves as a strategy to enhance creativity and provide focus for atopic in the learning process. Each classroom must develop a proper

display for students as they reach their specific goals. This strategy must contain a touch of every individual student. Participation must be on a voluntary basis, but the creativity touch must be made available to every student either by oral or written request.

Conclusion

The thought processes of reflecting upon my data helped me to delineate my own teaching experience. As I focused upon my classroom experiences, I obtained a critical and reflective perspective of the purposes of teaching. Using these reflections I acquired mastery of techniques and grasped the meaning of my own identity as a teacher. As I analyzed the classroom processes, I found responses and interpretations to questions. The analysis of previous situations resulted in reinforcing my classroom strategies, revising past experiences as I wrote upon anything that occurred in the classroom. I also discovered issues and problems that affect my future performance.

This process enabled me or the teacher to become a wiser practitioner. As a science teacher finding significance between concepts and events and connecting previous experiences is vital for my further development as a teacher. I discovered the importance of a dialogue with myself. I describe what really happened in the classroom with words, images, phrases and details. This examination of the main events permit

speculation about possible long term effects and future event anticipation in the practice.

The process of analyzing the classroom experiences permits revisiting situations focusing on main experiences and making necessary changes. These reflections upon my thinking enabled reflection on occurrences and situations that provided for issue clarification discovering possible solutions to problematic areas.

The development of wisdom-in-practice is the discovery and awareness of thought processes that identify possible conflicting areas in teaching. As I revisited situations focusing on experiences, I became a wise practitioner making necessary changes.

The analysis of classroom processes included revising my response and interpretation of a particular situation. This made it possible to follow my development and growth. In every journal comment, question or connection I revised my hidden system of values. I became a compromising analytical evaluator of past experiences as I planned for future applications of my outcomes.

The final outcome of these processes was the reinforcement of classroom strategies. The journal entries provided an open expression of the occurrences of the classroom. This opened a door for discovering issues and problems that happened in the practice.

The development of a wiser practitioner implies making connections about my own experiences as a science teacher finding similarities between concepts and events in science education. I developed a dialogue with myself asking questions about particular situations. I reframed what happened in my classroom with words, images, phrases and details. I also examined the main events searching for possible long term effects. The peculiarities of diverse conversations with myself made possible the understanding of my own teaching processes. The description of learning activities emphasized the importance of adapting instruction to the experiences or interests of my students. The end result of these conversations with myself acknowledged individual differences and cognitive styles opening new practices in teaching strategies.

This research study added to our knowledge about teachers and teaching. It describes the teaching-learning process using the observations of the classroom practice. It helps other researchers to understand the role of teachers, such as I, who are wiling to reflect about their own practice in order to improve it. It also provides for the verification that conversations can be an important tool doing research. This study encourages the study of other researchers contributing to theory development. The study provides vivid examples from my practice that teachers can be researchers contributing to important changes in the educational field.

BIBLIOGRAPHY

Abraham, J. (1989). Testing Hargreens' and Lacey's differentiation-polarization theory in a selected comprehensive. British Journal of Sociology 40(1).

Altrichser. H, Posch, P., Somekh, B. (1995). Teachers Investigate Their Work. London: Routledge.

Altwater, M. (1996). Social constructivism: Infusion into the multicultural science education research. City: John Wiley and Sons.

American Association of the Advancement of Science. (1983). Benchmarks for science literary. New York: Oxford University Press.

Anderson, R. (1978). Schema directed processes in language comprehension: Cognitive psychology and instruction. In A. M. Lesgold, J. W. Pellegrino, S. D. Folkslane & R. Glaser (Eds.), Name of Book (pp. 67-68). New York: Plenum.

Arendt. H. (1989). The human condition. London: LTD.

Ausubel, D. P. (1963). The Psychology of meaningful verbal learning. New York: Grune & Stratton.

Banks, J. A. (1993). Multicultural education: Historical development, dimension and practice. Review of Research in Education, 18, 3-49.

Banks, J. A. (1994). Multicultural education: Theory and practice (3rd ed.). Boston: Allyn & Bacon.

Banks, J. A., & Banks, C. A. (1995). Handbook of research on multicultural education (pp. 3-34). New York: Macmillan.

Banks, J. A., & Banks, C. A. (1995). Equity pedagogy: An essential component of multicultural education. Theory into Practice, 34(3), 152-158.

Barnes. D. (1976). From communication to curriculum. Harmondsworth: Penguin Books.

Basili, P. A., & Sanford, J. P. (1991). Conceptual change strategies and cooperative group work in chemistry. Journal of Research in Science Teaching, 28(4), 293-304.

Berlins, H. & Erlbaum, L. (1992). Piaget's theory: Prospects and possibilities.

Bereiter, C. 1985). Towards a solution of the learning paradox. Review of Educational Research, 55(2), 201-226.

Berlyne, D. E. (1965). Structure and direction in thinking. New York: Wiley & Sons.

Bloom, B. S.(1974). Handbook of formative and student learning. New York: McGraw-Hill.

Boyston, J. (1970). Guide to the works of John Dewey (pp. 84, 114). City: Publisher.

Brown, D. E., & Clement, J. (1989). Overcoming misconceptions via analogical reasoning: Abstract transfer versus explanatory model construction. Instructional Science, 18, 237-261.

Browne, R. (1984). Parental involvement: A Review of research and successful practice. Washington, DC: National Institute of Education.

Bryant, M. (1979). The Unexpected revolution: A Study in the history of the education of women and girls in the nineteenth century. London: University of London Institute of Education.

Cadzden, C. (1988). Classroom discourses: The Language of teaching and learning. New York: Cambridge University Press.

Caravita, S., & Hallden, O. (1994). Re-framing the problem of conceptual change. Learning and Instruction, 4, 89-111.

Carey, S. (1985). Conceptual change. Cambridge, MA: MIT Press.

Carey, S. (1989). An experiment is when you try it and see if it works A study of grade 7 students' understanding of the construction of scientific knowledge. International Journal of Science Education, 11, (special issue), 514-529.

Carr, W., & Kemmis, S. (1988). Becoming critical: Education, knowledge of action research (pp. 129-214). Philadelphia: Folmer Press.

Champagne, A. B., Gunstone, R. F., & Klopfer, L. E. (1985). Instructional consequences of students' knowledge about physical phenomena. In. L. H. T. West & A. L. Pine (Eds.). Cognitive structure and conceptual change. New York: Academic Press.

Chi, M. T. H. (1991). Conceptual change within and across ontological categories: Implications for learning and discovery in science. In R. Giere (Ed.), Minnesota studies in the philosophy of science, Vol 15. Minneapolis, MN: University of Minneapolis Press.

Chi, M. T. H., Slotta, J. D., & DeLeeuw, N. (1994). From things to processes: A theory of conceptual change for learning science concepts. Learning and Instruction, 4, 27-43.

Chinn, C. A., & Brewer, W. F. (1993, May). Theory change in response to contradictory information. Paper presented at the annual meeting of the American Educational Research Association.

Chomdky, N. (1980). Teacher practice: Plus queca change. In P. W. Jackson (Ed.). Contribution to educational change: Perspectives in research and practice (pp. 27-84). Berkeley, CA: McCutchen.

Clandinn, D. J., & Connally, F. M. (1986). Rhythms in teaching: The narrative study of teachers' personal practical knowledge of classroom. Teacher and Teachers Education (4), 377-387.

Clement, J. (1993). Using bridging analogies and anchoring institutions to deal with students' preconceptions in physics. Journal of Research in Science Teaching, 30(10), 1241-1257.

Clement, J. (1983). A conceptual model discussed by Galileo and used intuitively by physics students. In D. Gentner & A. Stevens (Eds.). Mental models (pp. 325-339). Hillsdale, NJ: Lawrence Erlbaum.

Clement, J. (1987). Overcoming students' misconceptions in physics: The role of anchoring intuitions and analogical validity. In J. D. Novak (Ed.). Proceedings of the second international seminar on misconceptions and educational strategies in science and mathematics (Vol. III, pp. 84-97). Ithaca, NY: Cornell University.

Clement, J., Brown, D. & Zectroina, A. (1989). Not all preconceptions are misconceptions: Finding "anchoring" conceptions for grounding instruction on students' institutions. International Journal of Science Education, 11, 554-565.

Cochran-Smith, M., & Lytle, S. (1990. Research on teaching and teaching reaching: The issues that divide. Educational Researcher, 19(2), 2-11.

Connally, M., & Ben-Peretz, M. (1978). The New York University biology achievement test: A case study of the relationship between curriculum policy, school program and external testing. Toronto: Ontario Ministry of Education.

Corno, L., & Kanfer, R. (1993). The role of volition in learning and performance (pp. 301-341). City: Publisher.

Creemers, B. P. (1996). Title. City: New York University Press.

Crown, C. S., & Rife, F. (1991). Social personality and gender difference in at-risk and not at-risk sixth grade students. Journal of Early Adolescence, 1'1, 482-495.

Cummions, S. (1986). Empowering minority students: A framework for intervention. Harvard Educational Review, 565, 18-36.

Curtis, S. (1996). An introduction to the philosophy of Education. City: Cambridge University Press.

Deforges, C., & Lockburn, A. (1987). Understanding the mathematics teacher. Basingtake, England: Falcom.

Dewey, J. (1929). The sources of science education (pp. 16, 19, 21, 75-77). City: Publisher.

Dewey, J. (1929). Democracy and education. City: Publisher.

Dewey, J. (1931). The way out of educational confusion. City: Publisher.

Dewey, J. (1939). Intelligence in the modern world (p. 673). City: Publisher.

Dierking, L., & Falk, J. (1994). Family behavior and learning in informal science settings: A review of the research. Science Education, 78, 57-72.

Duckworth, E. R. (1996). The having of wonderful ideas. City: Publisher.

Drumheller, S. (1985). Handbook of curriculum design for individualized instruction: A system. City: Publisher.

Driver, R. (1989). Students' conceptions and the learning of science. International Journal of Science Education, 11, 481-490.

Driver, R., & Scott, P. (1995). Mind in communication: A response to Erick Smith. Educational Researcher, 24(7), 27-28.

Driver, R., Asoko, H., Leach, J., Mortumer, E., & Scott, P. (1994). Constructivity scientific knowledge in the classroom. Educational Researcher, 23(7), 5-12.

Eisner, E. (1981). On the difference between scientific and artistic approaches to qualitative research. Educational Researcher, 10(6), 5-9.

Elliot, J. (1991). Action research for educational change (pp. 3-42). Milton Keynes, UK: Open University Press.

Epstein, J. (1988). Effective schools or effective students: Dealing with diversity. In D. Haskens, & D. MacRae (Eds.), Policies for American public schools. Norwood, NJ: Ablex.

Feldman A. (1991-1992). Action research: Reports from the field.

Feldman, A. (1992). Reports from the field, 1991-92. City: Publisher.

Feldman, A. (1994). Erzberger's dilemma: Validity in action research and science teachers' need to know. Science Education, 78(1), 83-101.

Feldman, A. (1995). Institutionalized action research and teachers' lives: The role of the facilitation in the California "100 schools" project. City: Publisher.

Feldman, A. (1995). Suggestions for writing the action research report for science teachers. City: Xerox.

Feldman, A. (1996). Enhancing the practice of physics teachers: Mechanisms for the generation and sharing of knowledge and understanding in collaborative action research. City: Publisher.

Feldman A. (1997). Varieties of wisdom in the practice of teachers, teaching and teacher education 13(7), 757-773.

Feldman, A. (1999). Conversation in teaching: Conversation as research A self-study of the teaching of collaborative research. City: Publisher.

Feldman, A., & Atken, J. (1995). Embedding action research in professional practice. City: Xerox.

Fetherston, T. (1997). Personal construct: Psychology and hearing. Approach Science Education, 7(19), 801-819. Perth, Australia: Edith Conan University.

Garcia, E. (1992). The state of multicultural education in USA. In K. A. Moodley (Ed.), Education in plural societies: International perspectives (pp. 47-66). Calgary, Alberta, Canada: Detsely.

Gilbert, J., & Watts, M. (1983). Concepts, misconceptions and alternative conceptions: Changing perspectives in science education. Studies in Science Education, 10, 67-98.

Gilligan, C. (1983). In a different voice: Psychological theory and women's development. Cambridge, MA: Harvard University Press.

Ginsburg, H. P., & Opper, S.. (1988). Piaget's theory of intellectual development. City: Publisher.

Grant, G., & Sleeter, C. E.. (1986). An analysis of multicultural education in the United States: Review 17 (pp. 421-444). City: Publisher.

Grasberg, H. P. (1988). Piaget's theory of intellectual development. Prentice-Hall.

Grossberg, S. (1983). Studies of mind and brain. Dordrecht, Holland: D. Reidel Press.

Hendler, O. (1959). John Dewey's challenge to education. City: Publisher.

Hampder-Turner, C. (1981). Maps of the world. City: Publisher

Heidegger, M. (1962). Being and time. City: Harper and Row.

Henderson, S. (19??). Introduction to philosophy of education. City: Publisher.

Hewson, P. W., & Hewson, M. (1992). The status of students' conceptions. In. R. Duit, F. Goldberg, & H. Neiddered (Eds.). Research in physics learnings: Theoretical issues and empirical studies (pp. 59-73). Kiel, Germany: Institute of Science Education.

Hoffman, D. (1996). Culture and self in multicultural education: Reflection in discourse, text and practice. City: Publisher

Hoover, N., & Caroll, R. (1987). Self assessment of classroom introduction: An effective approach to inservice education. Teaching and Teacher Education, 3, 179-181.

Hollingsworth, S. (1990, February). Coming to view teaching as research: A feminist perspective in an epistemological pedagogy for teachers. Paper presented to the American Association of Colleges of Teachers Education, Chicago.

Houston, W. R. (Ed.). (1990). Handbook of Research on Teachers' Education. City: Macmillan.

Hunter, M. (1994). Enhancing teaching. City: Publisher

Husserl, E. (1931). Ideas: A general introduction to pure phenomenology. City: Harper and Row.

Jackorn, P. W. (Ed.). (1992). Handbook of research on teachers. New York: Macmillan.

Karplus, R. (1977). Science teaching and the development of reasoning. Journal of Research in Science Teaching, 14, 169-175.

Kelly, G., Carlson, W., & Connagham, C. (1993),. Science education in sociocultural context: Perspectives from the sociology of science. Science Education, 77, 207-220.

Killiam, J., & McIntyre, D. (1986). Quality in the early field experiences: A product of grade level and cooperation teacher training. Teaching and Teacher Educator, 2(4), 367-376.

Kincherlor, J. (1992). The stigma of genius: Einstein and beyond modern education. City: Publisher.

Kohlberg, L. (1980). High school democracy and education for a just society. In R. Musher (Ed.). Moral Education: A first generation of research and development (pp. 20-57). New York: Praeger.

Kohlberg, L. (1981). Essays of moral development: Vol. I, The philosophy of moral development, moral stages and the idea of justice. San Francisco: Harper & Row.

Kohlberg, L. (1985). The just community approach to moral education in theory and practice. In. M. W. Berkwitz & F. Oser (Eds.). Moral education: Theory and application (pp. 27-87). Hillsdale, NJ: Erlbaum.

Kohlberg, L. & Candee, D. (1984). The relationship of moral judgment to moral action. In. L. Kohlberg (Ed.), Essays on moral development: Vol. II, The psychology of moral development: The nature validity of moral stages (pp. 488-581). San Francisco: Harper & Row.

Kuhn, T. (1970). The structure of scientific revolutions (2nd ed.). Chicago: University of Chicago Press.

Lakatos, I. (1978). The methodology of scientific research programs. New York: Cambridge University Press.

Lawson, A., & Beder, J. (1994, October). Cultural diversity and differences in formal reasoning ability. Journal of Research in Science Teaching, 2(7), 35-43.

Lawson, I, & Stover, J. R. (1989). Toward a solution of the learning paradox: Emerging properties and neurological principles of constructivism, Instructional Science, 80, 169-177.

Lee, V., & Brynk, A. (1988). Curriculum tracking as mediating the social distribution of high school achievement. Sociology of Education, 61(2), 78-94.

Lee, V., Brynk, A, & Smith, J. (1983). Effective secondary schools. Review of Research in Education, 19, 201-231.

Lewis, C. (1929). Mind and the world order: Outline of a theory of knowledge. New York: Charles Scribner & Sons.

Longino, H. (1990). Science as social knowledge: Values and objectivity in science inquiry. Princeton, NJ: Princeton University Press.

Luria, A. (1976). Cognitive development. Cambridge, MA: Harvard University Press.

Luria, A. (1961). The role of speech in the regulation of normal and abnormal behavior (J. Tizard, Ed.). Oxford: Pergamon.

Maturama, H. R., & Varela, F. J. (1992). The tree of the biological roots of human understanding. City: Publisher.

Mckernan, J. (1980). The continence of curriculum action research: Traditional collaborative, and emancipatory conceptions. Journal of Curriculum and Supervision, 3(3), 173-200.

Mestre, J., Dufresne, R., Gerace, W., & Hardman, P. (1988). Hierarchical problem solving as means of promoting expertise. In program of the tenth annual conference of the Cognitive Science Society (pp. 312-318). Hillsdale, NJ: Erlbaum.

National Assessment of Educational Progress. (1978). The third assessment of science, 1976-77. Denver, CO: Author.

National Center for Education Statistics. (1995). The condition of education, 1995. Washington, DC: U.S. Department of Education, OERI.

National Commission of Teaching of America's Future. (1996). What matters most: Teachers for America's future. New York: Columbia University Teachers College.

National Science Teachers Association. (1983). Educating Americans for the 21st century: A report to the American people and the National Science Board. Washington, DC: Author.

National Science Teachers Association. (1992). The content core. Washington, DC: Author.

Nine Court, A. (1984). Non-verbal communication. Evaluation, Dissemination and Assessment Center. Cambridge, MA.

Olson, J. (1980). Teacher constructs and curriculum change. Journal of Curriculum Studies 12, (1) 1-11.

O'Loughlin, M. (1989). The influence of teachers' beliefs about knowledge, teaching, and learning on their pedagogy: A constructivist reconceptualization and research agenda for teacher education. Paper presented at the Annual Symposium of the Jean Piaget Society, Philadelphia, PA, June 19, 1989.

Piaget, J. (1921). Biology and knowledge. Chicago: University of Chicago Press.

Piaget, J. (1922). Intellectual evolution from adolescence to adulthood. Human Development, 15, 1-12.

Paiget, J. (1928). Judgment and reasoning in the child. New York: Harcourt-Brace.

Piaget, J. (1929).

Piaget, J. (1952). The origins of intelligence in children. New York: International Universities Press.

Piaget, J. (1954). The construction of reality in the child.

Piaget, J. (1957). Logic and psychology. New York: Bone Books.

Piaget, Jr. (1964). Cognitive development in children: Development and learning. Journal of Research in Science Teaching, 2(2), 176-186.

Piaget, J. (1966). Psychology of intelligence. To Tonva; NJ: Littlefield Adams.

Piaget, J. (1968). The moral judgment of the children. New York: Humanities Press.

Piaget, J. (1971, May 20). Problems of equilibrium. In C. I. Nodive, J. M. Gallegher, & R. H. Humpreys (Eds.), Piaget and Enhelder: On equilibration. Proceedings of the first annual symposium of the Jean Piaget Society, Philadelphia: The Jean Piaget Society.

Piaget, J. (1976). Piaget's theory. In B. Enhelder & H. H. Chipment (Eds.), Piaget and his school. New York: Springer-Verly.

Piaget, J. (1977). The grasp of consciousness. London: Routledge and Kegen Paul.

Piaget, J. (1978). Behavior and evolution. New York: Random House.

Piaget, J. & Enhelder, B. (1969). The psychology of the child. New York: Basic Books.

Piatelli-Palmerini. (1996). Language and learning: The debate between Jean Piaget and Noah Chomski. Cambridge, MA: Harvard University Press.

Popper, K. (1959). The logic of scientific discovery. London: Hitchison.

Renner, J. & Merek, E. (1988). The learning cycle and elementary school science teaching. Portsmouth, NH.

Renner, J., Abraham, M., & Birnie, H. (1985). The importance of the form of students' acquisition of data in physics learning cycle. Journal of Researching Science Teaching, 22, 303-325.

Rice, J. (1893). The public school system of the United States. New York: Century.

Rivera-Medina, E. (1984). The Puerto Rican return migrant student: A challenge to educators. Educational Research Quarterly, 8, 82-91.

Rivera, C., & Zehler, A. (1990). Collaboration on teaching and learning: Findings from the innovative approaches research project. Arlington, VA Development Association. New York: Department of Education, Cornell University.

Rivers, W. (1989). Ten principles of interactive language teaching. Washington, DC: Johns Hopkins University National Foreign Language Center.

Rogoff, B. (1989). Apprenticeships in thinking. New York: Oxford University Press.

Schawab, J. (1969). The practical language for curriculum. School Research Review 78(1), 1-24.

Schön, D. (1983). The reflective practitioner: How professionals think in action. New York: Basic Books.

Schön, D. (1985). The design studio. London, RBA Publications Ltd.

Schön, D. (1991). The reflective turn: Case studies in and on educational practice. New York: Teachers College Press.

Scott, P. (1987). The process of conceptual change in science: A case study of the development of a secondary pupil's ideas relating to matter. Vol. II, 404-419.

Seaberg, D. (1997). The four faces of teacher. New York: New York University Press.

Sears, S. J., & Hush, S. (1994). Preparing teachers to use contextual teaching and learning strategies to enhance student success in and beyond school.

Seidmen, E. (1991). Races, class, gender, and disability in current textbooks. In M. W. Apple and L. K. Christian-Smith (Eds.). The politics of the textbook 78-110. New York: Routledge.

Sizer, T. (1985). Horace's compromise: The dilemma of the American school. Boston: Houghton-Mifflin.

Sizer, T. (1989). Horace's Hope. Boston: Houghton-Mifflin.

Smith, M. U. (1991). Forward a unified theory of problem solving: Views from the content domain. Hillsdale, NJ: Lawrence Earlbaum.

Sockett, H. (1992). The curriculum as a shaping force. City: Publisher, pp. 545-549.

Steinberg. (1998). Genius did not immune to persistent misconception: Conceptual difficulty impending Isaac Newton and contemporary physics students. Handbook of Research in Science Teaching and Learning, 3457-461.

Stenhouse, L. (1985). A note on a case study and educational practice. In R. Burgess (Ed.), Field methods in the study of education. Philadelphia: Palmer Press.

Strike, K. & Posner, G. (1992). A revisionist theory of conceptual change. In R. Duschl & R. Hamilton (Eds.), Philosophy of science, cognitive science, and educational theory and practice. Albany, NY: Suny Press.

Tharp, R. & Gallimore, R. (1988). Focusing minds to life: Teaching learning and schooling in social context. Cambridge, England: Cambridge University Press.

Tharp, R. & Gallimore, R. (1988). Rousing minds to life: Teaching learning and schooling in social context. Cambridge, England: Cambridge University Press.

Tharp, R. & Gallimore, R. (1988). Challenging cultural minds. London: Cambridge University Press.

Thorndike, E. (1910). The contribution of psychology to education. The Journal of Educational Psychology I, 5-12.

Thorndike, E. (1913). Educational psychology. New York: Teachers College, Columbia University.

Thurstone, L. (1934). The vectors of mind. Psychological Review 41(1), 1-32.

Toulmin, S. (1979). The inwardness of mental information. Critical Inquiry, 6, 1-16.

Trueba, H. (1988). Rethinking learning disabilities: Cultural knowledge in literary acquisition. Unpublished manuscript, Office for Research on Education Equity, Graduate School of Education, University of California, Santa Barbara.

Trueba, H. (1988). Success or failure? Learning and the language of minority students. Scranton, PA: Harper & Row.

U.S. Department of Eduction (1995). Center for Education Statistics. National education longitudinal study of 1988: Second follow-up 1992 in trends among high school seniors. Washington, DC: U.S. Department of Education.

Usher, R. & Scott, D. (1996). Understanding educational research. Rusthledge: 11 Neftter Soc. London.

Valverde, T. (1982). The self evaluating supervisor. T. Seigrovanic (Ed.). Supervision of teaching. Alexandria, VA.

Van Dijk, T. (1993). Principles of discourse analysis. Discourse and Society, 4, 249-283.

Von Glaserfeld, E. (1995). The constructivist approach to teaching. In L. Steffe & J. Gale (Eds.). Constructivists in education. Hillsdale, NJ: Lawrence Earlbaum Associates.

Vygostky, L. (1962). Thought and language. Cambridge, MA: MIT Press.

Vygostky, L. (1962). The problem of the cultural development of the child. Vygostky Reader: MIT Press.

Vygostky, L. (1962). Tool and symbol in child development. Vygostky Reader: MIT Press.

Wadsworth, B. J. (1979). Piaget, J. theory of cognitive and affective development. Logan.

Wallace, M. (1987). A historical review of action research: Some implications for the education of teachers in their managerial role. Journal of Education for Teaching, 13(2), 97-115.

Watchtel, L. (1995). Headlong into inside out: The process of becoming an effective multicultural science teacher. Paper presented at the annual meeting of the American Educational Research Association. San Francisco, CA, April 18, 1995.

Whittrock, M. (Ed.). (1986). Handbook of research on teaching, 3rd ed. New York: Macmillan.

Zais, R. (1976). Curriculum principles and foundations. New York: Harper & Row.

Zechner, K., & Lester, D. (1991). Teaching student teachers to reflect. Harvard Educational Review, 57, 23-48.

Zimmerman, B. J. (1988). Construct validation of a strategy model of student self-regulated learning. Journal of Educational Psychology, 80, 284-290.

Zimmerman, B. J. (1990). Self-regulation academic learning and achievement: The emergence of a social cognitive perspective. Educational Psychology Review 2, 173-201.

Zumwalt, K. (1989). Beginning professional teaching: The need for a curricular vision of teaching. In Knowledge Base for the Beginning Teacher, M. C. Reynold (Ed.). Oxford, England: Pergamon.