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A study of teachers' perceptions about staff development factors and their classroom implementation of reform-based science instruction

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A STUDY OF TEACHERS' PERCEPTIONS ABOUT STAFF DEVELOPMENT FACTORS AND THEIR CLASSROOM IMPLEMENTATION OF REFORM-BASED SCIENCE INSTRUCTION

by

Debbie Thompson Silver, B.S., M.Ed.

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

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We hereby recommend that the dissertation prepared under our supervision by Debbie Thompson Silver entitled A Study of Teachers' Perceptions About Staff Development Factors and Their Classroom Implementation of Reform-Based Science Instruction be accepted in partial fulfillment of the requirements for the Degree of Doctor of Education

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Dean of the College

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ABSTRACT

The purpose of this study was two-fold: 1) to determine whether or not there were significant differences in implementation levels of reform-based science instructional strategies by teachers who participated in an established staff development program, Project LIFE, and those who did not, and 2) to distinguish specific program factors that may have impacted the level of implementation of reform-based instructional classroom practices. The instrument used, the *Survey of Reform-Based Science Teaching Strategies (SRBSTS)*, was developed by the researcher and had reliability of .912 as measured by Cronbach Alpha.

An independent samples t-test analysis was used to compare the implementation levels of a random sample (n=40) of Project LIFE teachers and a control group of non-Project LIFE teachers (n=34). The random sample (n=40) was drawn from the experimental group (n=148) which included former teacher participants (from seven different summer programs and follow-up years, 1992-1998) who responded to the mail-in survey. All respondents reported on Likert-type scale inventories about their estimated percentage of time spent on reform and non-reform-based science instructional practices.

Additionally the experimental group responded to 40 Likert-type scale items about their perceptions of five staff development program components. A stepwise multiple regression analysis between the dependent variable, levels of implementation, and the independent variables, five program components, determined that positive levels of implementation could be predicted (p = .05) by only one program comonent, the participant's favorable perception of the program's core values (i.e. belief that reform

methodologies offer the best way to help students learn science). Perceptions about the initial training experience, program follow-up, program support, and school/district support showed no significant correlation.

The study concluded that the Project LIFE teachers showed significantly higher positive levels of reform-based instructional practices, and that their positive perceptions about the value of the staff development program objectives is the single-most important factor influencing post-training practices. These findings are important in enhancing national science reform goals because they contribute to an understanding of which factors in staff development programs for practicing teachers most contribute to transfer of training.

DEDICATION

This dissertation is dedicated first and foremost to my soul mate, my touchstone, and my partner in life. Lawrence, you truly are "the wind beneath my wings."

And for each of their unique and individual contributions to my life I dedicate this work to our children: Scott, Maverick, Stephanie, Andy, Jeremy, Kandy, and Kit.

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I wish to thank Dr. Mary Jo McGee-Brown for inspiring this research project. She taught me what it means to be a qualitative researcher, offered wise counsel over the two years I have worked on this study, and has always been there for me.

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CHAPTER I

INTRODUCTION

Purpose of the Study

The purpose of this study was two-fold: 1) to determine whether or not there were significant differences in implementation levels of reform strategies by teachers who participated in an established staff development program, Project LIFE, and those who did not, and 2) to distinguish specific program factors that may have impacted the level of implementation of reform-based instructional classroom practices. There are few well-designed long-term staff development studies of (a) the extent to which participants actually implemented the staff development program objectives into their classrooms during following years, and (b) which factors were most important to the implementation of the instructional behaviors. Through a comparison of teachers' perceptions about various staff development program factors and subsequent levels of implementation of reform-based science teaching practices during the years following their inservice training, the intent of this study was to help program planners design professional development programs which will meet the needs of teachers, facilitate implementation of newly learned skills, and foster achievement of national goals.

Significance of the Problem

The American Association for the Advancement of Science (AAAS, 1989, 1993, 1998) is concerned that without high-quality professional development, national standards and state curriculum frameworks may appear to teachers to be little more than

highly abstract philosophies. Researchers are now aware that effective staff development is intrinsic to initiating reform-based teaching as well as implementing other national goals. At the federal level increased support for the professional development of elementary and secondary teachers was added to the national education goals through the Goals 2000 legislation (National Education Goals Panel, 1994). However, additional funding of staff development programs does not necessarily guarantee successful implementation of reform-based instructional strategies in the classroom.

Hirsch and Ponder (1991) report that as few as 10 percent of teachers transfer learning from their professional development experience to the classroom. Researchers are becoming interested not only in the quality of staff development training but in the factors which enhance and impede the transfer of the behaviors learned once the staff development sessions are completed (Guskey, 1986; Guskey & Huberman, 1995; Loucks-Horsley, Hewson, Love, & Stiles, 1998; Reys, Reys, Barnes, Beem, & Papick, 1997; Sparks & Hirsh, 1997; Showers & Joyce, 1996; Veenman, Tudler, & Voeten, 1994). Suggestions for new kinds of professional development abound, but with few empirical studies of the long-term results of professional development efforts, it is difficult to know which factors are essential for the transfer of training into the classroom. It is imperative that studies be done so that staff development programs can help bridge the gap between America's vision of education in the twenty-first century and the ability of schools to reach those goals.

Hypotheses

The hypotheses which guided this study were:

1. Project LIFE, an established science staff development program, produced a higher level of implementation of reform-based science

instructional practices in the classrooms of its participants as compared to a similar group of non-Project LIFE science teachers.

2. Teacher perceptions of staff development program factors of initial training, project follow-up, project support, school/district support, and commitment to the value of the program's goals significantly predict a positive level of implementation of reform-based instructional practices in Project LIFE classrooms.

Definitions

Reform-Based Instruction

Reform methodologies called for in national standards and benchmarks require a fundamental change in the traditional concept of teaching. Heavy emphasis on teacher-centered lecture methods and over-reliance on textbooks are replaced with more student-centered learning (i.e. inquiry-based lessons; cooperative learning strategies; hands-on/minds-on activities; learning cycle lesson structures, and more). Teachers are expected to integrate instruction among disciplines, teach with more depth and less breadth, and move towards authentic assessment. When planning curriculum, educators are asked to incorporate emerging findings of brain research along with principles of individual learning styles and multiple intelligences. Additionally, teachers are responsible for utilizing newly available technology, addressing issues of equity and problems of diversity, and building partnerships with parents and the community (Lasley, Matczynski, & Benz, 1998; National Research Council, 1996a; Willis, S., 1995).

Staff Development

For purposes of this study *staff development* will be used interchangeably with the terms *professional development*, *inservice training, teacher enhancement*, and *teacher training*. All will be used to describe the process of enabling experienced teachers to learn new content knowledge and new methods of instruction through a continued effort to enhance current understandings, beliefs, abilities, and practices.

Transfer of Training

In the context of this study *transfer of training* refers to the acquisition of new beliefs, knowledge, and teaching practices (through inservice training) which are in turn generalized to the job setting and maintained over a period of time. It is hoped that these newly acquired behaviors will become internalized and will be evident for the duration of the teacher's career (Stein and Wang, 1988; Veenman, et al., 1994).

Level of Implementation

Within this study *level of implementation* indicates the amount of transfer and maintenance of the learned practice. Levels were collected through a self-report instrument on which teachers indicated the percentage of time they spent on reform- and non-reform-based instructional strategies.

The Project LIFE Program Model

Project LIFE is a staff development program for practicing teachers of life science and biology for grades 5-12. It was developed through funding by the Louisiana Systemic Initiatives Program (LaSIP) and is currently funded by the National Science Foundation (NSF). During its first seven years of implementation, Project LIFE targeted classroom science teachers with help in upgrading their science content knowledge, improving their instructional methodologies, and focusing on reform-based

teaching techniques. The basic staff consisted of a biology instructor, a chemistry professor, a science education professor, and a middle grades science teacher who acted as site coordinator. Each program year had different ancillary staff members bringing the total number of staff to a range of four to seven.

Initial inservice took place in the summer, and follow-up was provided for one year immediately following the training. In years one through five the summer inservice segment consisted of intensive all-day training for three weeks; in years six and seven the model was modified to reduce the inservice training to two weeks. A leadership component was added to the program in Year 2, 1993, and was offered thereafter. Past Project LIFE participants were invited back to the sponsoring university for training in how to present life science workshops and how to act as mentors to other teachers. Approximately 20 percent of Project LIFE participants volunteered for this additional training. This study focused on only the initial training experience and follow-up year for each participant.

Through grant funding the Project LIFE Program was able to pay participants $60.00 per day as a stipend for attendance, and in most cases, provide a room and travel reimbursement. Participants were given an allotment of $200 - $400 (depending on the amount of local support) for materials and supplies which were ordered in the summer and delivered to them prior to the beginning of school the following term. Motivational items such as t-shirts, certificates, and door prizes were used throughout the program to bolster participant morale.

Participants were required to keep daily journals reflecting their feelings about components of the inservice program and about themselves as learners. The journals were read by the site coordinator who wrote daily responses to comments and concerns as well as words of support. Each day the site coordinator generated an anonymous composite list of all comments and concerns from participants to share with other project

instructors so that problems and suggestions could be addressed by the entire staff in a timely fashion.

A learning log was kept by each participant to record data about long-term investigations, to answer questions posed by the staff, and to ask questions of a scientific nature. The learning logs were rotated among staff members on a regular basis so that an ongoing dialogue about scientific issues was maintained between each participant and the project instructors.

The program used hands-on/minds-on life science activities as a vehicle for enhancing the goals of the national reform efforts. After reviewing the literature about reform-based science instruction and change process, the developers of Project LIFE created a holistic approach to staff development. Participants were immersed in the practices Project LIFE staff wanted them to replicate in their own classrooms. Project LIFE staff believed that the *medium is the message*, and therefore, used cooperative learning, alternative assessment, inquiry learning, the learning cycle, active learning, and other reform-based practices throughout the initial inservice experience as well as in follow-up workshops. Opportunities were intentionally put in place to foster positive attitudes in participants towards the reform goals. Teachers were asked to take on the role of learner in every sense of the word. They were encouraged to experiment, to discuss, to reflect, and to write daily about their feelings. Project LIFE followed Lauriala's suggestion (1992) and targeted not only the acquisition and renewal of particular knowledge and skills, but deeply focused on teachers' perceptions, attitudes, values, and understandings.

Assumptions

Project LIFE Embodies and Promotes The Reform-Based Instructional Practices Set Forth in National Goals

The Project LIFE Program consisted of a three-week or a two-week intensive course hosted at the sponsoring north Louisiana university during years one through five and at cooperating universities (in east Texas and in southern Arkansas) in years six and seven. Each teacher participant designed and carried out an individual research project that was presented at a Science Expo at the specific host site in August of each project year.

Follow-up workshops throughout the year were conducted on Saturdays at the host sites (six at each site in years one through six and four at each site in year seven). Teacher participants' classrooms were visited by the site coordinator who collected data about program implementation, assisted teachers with labs and field trips, did demonstration lessons, talked with participants' administrators, and generally provided affirmation and feed-back to the participants. Periodic newsletters were mailed, and other communications continued during the follow-up year. Some training for administrators was offered, and participant involvement in local and state science organizations was encouraged.

Project LIFE demonstrated immediate positive impact on reform-based science teaching in selected classrooms of Arkansas, Louisiana, and Texas. Data from the program's teacher participants indicated that during their initial training, participants improved their understanding of science content and science process skills, gained confidence in their ability to teach science through investigative activities, and became enthusiastic about helping their students understand the content and process of science (McGee-Brown, 1998; Radford, 1998). Teachers reported that through their inservice

training in Project LIFE they learned science concepts, instructional strategies, assessment techniques, and classroom management strategies (McGee-Brown, 1998; Radford, 1998; Radford, Ramsey, & McGee-Brown, 1998). Follow-up classroom visits indicated that in the year following their initial summer training program teachers used a variety of reform strategies to engage their students in science inquiry (McGee-Brown, 1998). Because of Project LIFE's established history as a successful inservice model for immediate transfer of training, its participants were selected for this follow-up study on factors affecting implementation of reform-based teaching practices in the classroom.

Professional Competency

Professional development is not about lack of competency or inadequacy; it is about growth and refinement. The vast majority of teachers and administrators are highly committed and caring individuals who possess the knowledge and skills requisite to being effective educators (Kyle, 1995).

Teaching as an Art

Teaching is more than the technology of studying and applying sound techniques. It is an art which intricately weaves mechanical skills with experience and tacit knowledge. In viewing the art of teaching as more than an implementation of accepted practices, staff development planners must provide opportunities in which teachers can participate in a continuing process of change which is both developmental and experiential (Darling-Hammond, 1996).

Teachers as Adult Learners

Adults learn best when they understand why they need to know or be able to do something; they have a need to be self-directing and are motivated by enhanced self-esteem and job satisfaction as much as by extrinsic factors (O'Brien, 1992).

Limitations

Generalizability Limitations

Since the Project LIFE teachers in this study were members of an intact cohort, certain limitations inherent in the study may reduce generalizability of results. Consequently, findings from this study may be more applicable to professional development programs of a similar nature.

Self-Report Survey Limitations

In order to address the *truthfulness* problem associated with self-report instruments outlined by Popham (1993), the researcher (a) made the survey responses anonymous and (b) attempted to shift the focus of the respondent away from one that contaminates the participants' responses. As suggested by Popham (1993), participants were provided with an opportunity to supply additional information and suggestions regarding the program.

Researcher Subjectivity

The researcher was one of three primary developers of the biological science teacher inservice program, Project LIFE, as well as site coordinator for the program for six of the seven years that Project LIFE was offered. Responsibilities of the site coordinator included: curriculum development, instruction and training, follow-up classroom visits, newsletter publishing, workshop designing, and recruiting new participants.

The researcher's interactions with teacher participants over seven years resulted in many biases and expectations about the Project LIFE Program. It was critical, therefore, for the researcher to generate a scoring rubric for the data collection instrument which was quantitative and which allowed participants to complete it anonymously. A cover letter was sent explaining that the researcher was no longer a member of the Project LIFE staff and was interested in their *most truthful* answers for research purposes.

The researcher observed implementation of Project LIFE in almost every teacher's classroom at least two times during the year immediately following the teacher's initial summer program. Data were recorded on a standard classroom observation form; there was an awareness of the degree to which each teacher implemented Project LIFE instructional reform-based strategies in the year immediately following program participation, but there had been no study of the long-term effects of the program. Many comments from teacher participants about factors which influenced their success in implementing reform-based science teaching strategies were documented, but there had been no attempt to quantify these nor to determine their long-term influence on classroom performance by participants.

Significance of the Study

Professional development has received increasing emphasis as a result of several reform-based movements in the United States. In spite of the acknowledged importance of staff development for improving the quality of teaching and learning, much still remains to be learned about how effective inservice training takes place. Mathison (1992) indicates that millions of dollars and service hours are spent on staff development for teachers in the United States every year. Considering the large amounts of financial resources invested in staff development programs, it is imperative

that researchers extend their limited knowledge of the design features which best promote successful implementation of effective strategies put forth in inservice training. "Transfer of training is still a major problem with concerns that teacher behaviours [sic] acquired are not being generalised [sic] to the job context and maintained over a period of time on the job" (Conners, 1995, p. 10).

The need for inquiry into how professional development programs impact science education has been identified as a science education research priority. Through gathering empirical evidence about teacher perceptions of various program factors, this researcher's intent was to add to the body of knowledge regarding factors which influence successful implementation of reform-based strategies in the classroom.

In summary, there are few well-designed staff development studies of (a) the extent to which participants actually implement the staff development program components into their classrooms subsequent to their training and (b) teacher perceptions about factors that support transfer and maintenance of the practice. The governing idea of this study was that findings regarding teacher perceptions about specific factors in their Project LIFE inservice experience compared to their levels of post-training implementation of reform-based science teaching practices in their classrooms could be used to improve other professional development programs designed to help educators reach national goals in science education.

CHAPTER II

REVIEW OF THE LITERATURE

Overview

The review of literature related to professional development for reform-based science teaching instructional strategies is grounded in the theoretical framework that reform-based science education is desirable and necessary to achieving America's national goals for education. The literature suggests that these goals will not be met unless teachers receive appropriate information and training consistent with the national goals. Because experienced teachers sometimes lack the necessary knowledge and skills needed to implement reform-based science strategies in their classrooms, and because the new information about what and how to teach is continually evolving, it is vital that ongoing staff development programs fill the gap between what is desired for instructing students and what teachers are trained to provide.

Adult learners have unique ways of acquiring knowledge and transferring newly learned skills. Research indicates that some of the following factors may influence the transfer of newly learned teaching practices to the classroom: quality of the initial inservice training program, program follow-up, program support, school/district support, and personal commitment to the program.

One purpose of this study was to examine teacher participant perceptions about staff development program components in a science inservice training project which may have impacted their transfer of training to classroom practice. In order to explore

the subject fully, literature was reviewed about the nature of the reform-based science education movement; the teacher as a key to providing reform-based instructional change; the importance, the history, the present state, and the future of staff development in the school setting; and professional development program factors which have previously been identified as enablers and obstacles (i.e. initial inservice training, program follow-up, support from the program, school/district support, and personal commitment to the program).

Call for Reform-Based Science Education

Ongoing large-scale science educational reform efforts have been set forth by national groups (American Association for the Advancement of Science [AAAS], 1989, 1993, 1998; National Research Council [NRC], 1996a; National Science Teachers Association [NSTA], 1992; National Science Foundation [NSF], 1998). These organizations have set ambitious goals for schools, teachers, and students. Teachers are asked to help students construct meaning for themselves through active learning experiences; probe more deeply and critically into fewer important topics; pose their own questions; design and pursue their own investigations; analyze data; apply science knowledge to daily life; invent, create, present their findings; and leave school as science literate citizens and lifelong learners. "Classrooms are to be places where teachers and all students engage in rich discourse about important ideas and explore interesting problems grounded in meaningful contexts" (Borko & Putnam, 1998, p. 1).

These mandates for innovation represent a significant departure from traditional classroom expectations. Recent research into how students learn has added to the quandary of how best to instruct and assess achievement within the confines of reform methodology. The visions proposed by reform-minded institutions cannot be met without a substantial change in the beliefs, knowledge, and teaching practices of

experienced teachers. Transformation from traditional to reform-based science classrooms cannot take place without rigorous training and sustained guidance for the teachers involved (Haney, Cerzniak, & Lumpe, 1996; Reys et al., 1997). Professional development in reform-based science teacher training is, therefore, essential to any desired reform efforts at implementing a new kind of science curriculum. Some theorists believe that changing beliefs about science and how it should be taught and learned is desirable if it brings about a different way of promoting student learning and a higher rate of teachers' professional development (Aríza & Gómez, 1992). It is not inconceivable that improved staff development will positively affect classroom practices, and likewise, improved classroom practices will encourage better staff development.

Teacher as the Key

Numerous researchers believe that the key to any and all reform strategies lies within the classroom teacher (Anderson, 1998; Aríza & Gómez, 1992; Darling-Hammond, 1996; Lauriala, 1992; O'Brien, 1992; Sykes, 1996). Some statistics about current teaching practices do not look promising for reform. The 1993 National Survey of Science and Mathematical Education conducted by Horizon Research, Inc. asked 6,000 U.S. teachers of mathematics and science in grades 1-12 about their practices and beliefs. Here are some of the findings:

- About 70 percent of elementary and middle grade teachers, and fewer than 60 percent of high school teachers, agree that science and math should provide deeper coverage of fewer concepts.
- Many teachers resist the advice of reformers to teach science concepts *before* teaching the terminology associated with those concepts. Nearly one-third of teachers of grades 1-4, and about one-half of high school teachers, responded that *it is important for students to learn basic*

scientific terms and formulas before learning underlying concepts and principles.

- Approximately 30 percent of teachers of grades 1-4 believe that cooperative learning is an effective way to teach science and math, and 70 percent of high school teachers hold this view.
- Elementary teachers tend to be confident in their ability to use reform-oriented teaching strategies (such as cooperative learning and the learning cycle), but do not feel confident in their ability to teach a number of elementary science content areas.
- High school teachers tend to be more confident in their subject areas, but are less confident in their ability to use reform teaching methodologies and are less likely to use them in their classrooms. (Weiss, 1993)

In light of these findings it is questionable whether United States teachers of science are truly ready to embark on teaching to the new standards with reformed methodologies. Gibbons, Kimmel, and O'Shea (1997) assert that the new teaching behaviors that will assure achievement of content standards are not present in today's teacher work force. Lasley et al. (1998) contend:

> The direction and depth of curricular change might require that all teachers engage in a dialogue about the essential science content that students should know in depth. Such dialogue is now occurring within the leadership of science organizations, but it also must occur at the grassroots, classroom level. If new approaches to science teaching are desired in classrooms, teachers must be more than passive participants in the dialogue about change; they must think about how to change their own classrooms. (p. 128)

Given the movement in instructional emphasis toward more teacher inquiry, more collegiality in learning, and the integration of knowledge, reform advocates still face the problems of how to change teacher attitudes and teacher behaviors (Lowery, 1997). Curriculum planners warn that teachers must not be left out of the loop:

> Much of the work of school innovation undertaken during the last few decades has been unsuccessful because it has bypassed the role of teachers and their thinking. The technical and political innovation strategies in particular have entailed the assumptions that innovations are exportable and that teachers will automatically and rather uniformly implement innovations created by someone outside. (Lauriala, 1992, p. 523)

Most reform strategists concur with Darling-Hammond (1996) that ". . . we must put greater knowledge directly in the hands of teachers and seek accountability that will focus attention on *doing the right things* rather than on *doing things right*" (pp. 5-6).

Speaking to the issue of the importance of the teacher in regard to the reform movement, Little (1990) captures the situation:

> Conditions that motivate teachers or discourage them may do so both for the moment -- affecting the ebb and flow of energy and engagement teachers bring to their daily work -- and for the long term, bolstering or eroding their overall investment in teaching. In affecting the orientation that individual teachers hold toward their work, such pervasive realities also enhance or sap the collective capacity of a school to educate its students. (p. 188)

If one believes that teachers truly are the key, then what is the answer to the dilemma of untrained or unmotivated teachers? Most agree that the next logical step is to train experienced teachers through staff development.

Staff Development

This study examined staff development program factors which may have influenced participants' subsequent levels of implementation of reform-based classroom practices; it was anticipated that findings from this study could be used to design better staff development programs to assist teachers in transferring and maintaining newly learned reform-based behaviors in the classroom. Refinement of the process of staff development cannot be achieved without clear understandings about its nature. This section explores several aspects of staff development: its importance, its history, its present state, the need for more research, and its future.

Importance of Staff Development

The American Association for the Advancement of Science (AAAS, 1989, 1993, 1998) is concerned that without high-quality professional development, national standards and state curriculum frameworks may appear to teachers to be little more than highly abstract philosophies. At the federal level increased support for the professional development of elementary and secondary teachers has been added to the national education goals through the Goals 2000 legislation (National Education Goals Panel, 1994). In November, 1997, President Clinton signed an appropriations bill that included an additional $25 million for teacher professional development (Moreno, 1998).

The reform movement is calling forth new images of what constitutes good teaching. Teachers are faced with the challenge of learning to do something new for which there are few examples. Basic assumptions need to be reconsidered and rebuilt (Fleming, 1998; Wilson, Peterson, Ball, & Cohen, 1996). The need for science teachers in particular to become immediately involved in staff development is underscored by the fact that "as soon as science teachers begin their careers, they embark upon a journey towards obsolescence" (Harty & Enochs, 1985, p. 126).

There is widespread agreement among educators that the gulf between proposed and actual significant lasting school change can only be surmounted by a fundamental transformation in the process of professional development (Acquarelli & Mumme, 1996; Anderson, 1998; Darling-Hammond & McLaughlin, 1995; Finson, 1989; Harty & Enochs, 1985; Lieberman, 1995; Sparks & Hirsh, 1997.) " . . . The bridge connecting the real to the ideal world needs to be built on quality staff development and support" (O'Brien, 1992, p. 422).

Fullan & Miles (1992) note that staff developers have a much bigger role to play in teacher development than has ever been realized before. Researchers are now aware

that effective staff development is intrinsic to initiating reform-based teaching as well as implementing other national goals. Fullan (1995) conceives professional development as being "integral to accomplishing moral purpose, as central to continuous improvements in professional work cultures, and as embedded in the continuum of initial and career-long teacher education" (pp. 264-265). Darling-Hammond and McLaughlin (1995) suggest that there is a strong link between a reform agenda and career-long conception of teacher learning:

> The success of this agenda ultimately turns on teachers' success in accomplishing the serious and difficult tasks of learning the skills and perspectives assumed by new visions of practice and unlearning the practices and beliefs about students and instruction that have dominated their professional lives to date. Yet few occasions and little support for such professional development exist in teachers' environments. (p. 597)

Joyce (1990) states it succinctly with this admonition, "The future culture of the school will be fashioned largely by how staff development systems evolve" (p.xv).

History of Staff Development

According to Joyce (1990) until 23 years ago, very few school districts accepted responsibility for the academic or social health of their school personnel. Services for teachers and administrators were actually declining. During the early 1970s, however, national, regional, and local leaders gradually began to realize that their teachers were virtually unsupported in the sense of being provided with continuing education. Even those who did participate in inservice training did not always apply what the program presented. According to Showers & Joyce (1996):

> In the 1970s, evaluations of staff development that focused on teaching strategies and curriculum revealed that as few as 10 percent of the participants implemented what they had learned. Rates of transfer were low even for those who had volunteered for the training. Well-researched curriculum and teaching models did not find their way into general practice and thus could not influence students' learning environments. (p. 12)

Sparks and Hirsh (1997) voice the hope that there will be no new inservice presentations such as those in the past when teachers sat passively while an "expert" exposed them to new ideas or "trained" them in new practices, nor do they want the superficial "happiness quotient" instruments which were used in the past to determine the program's effectiveness.

Sykes (1996) describes many of the early attempts at teacher training as "one-shot workshops," educational shorthand for superficial, faddish inservice education that supported a mini-industry of consultants without having much effect on what went on in schools and classrooms. O'Brien (1992) refers to this type of workshop as the "spray and pray" or the "hit and run" lecture variety. He, along with others, believes that these meager attempts at staff development had little or no positive effect on the teaching/learning process in the classroom. Campbell (1997) agrees that one-day workshops have limited use:

> Although some would argue with the notion that the "one-off" staff day of the 1970s and early 1980s has run its race, there is still room for this style of offering -- for example, to instruct on and discuss with teachers such topics as emergency care or new administrative procedures. Sensibly, though, education of the 1990's is moving away from the often isolated one-off approach to staff training and development. (p.26)

In the past professional development activities were aimed primarily at adding to a teacher's bag of tricks rather than to revolutionize teachers' entire perspective on how learning occurs (Gough, 1996). For the most part, inservice programs in the past have emphasized teacher training aimed at providing knowledge and skills development. Given this focus, the lack of utilization of newly acquired knowledge and skills by teachers in their classrooms day-to-day is not surprising (Stein & Wang, 1988). Veenman et al. (1994) describe typical inservice workshops (before reform) as being individual teachers from several schools who were grouped together for a pre-specified goal. They state that individual teachers often encountered problems while attempting to

implement the newly acquired skills or ideas, but there were no convenient resources available for help or sharing with colleagues. Additional ways that traditional inservice programs have failed to meet teacher needs are that they served to infantilize the profession by requiring teachers to attend inservice provided largely by non-teachers (Ingvarson, 1998), and they largely ignored the influential nature of teacher beliefs on changes in teaching practice (Haney et al., 1996).

Present State of Staff Development

Staff development has grown unevenly, but it is now established. "Today we can say that staff development is a living component of the educational system in North American and abroad" (Joyce, 1990, p. xvi). Critics of popular staff development policies are still not pleased with its current state (Anderson, 1998; Aríza & Gómez, 1992; Darling-Hammond, 1996; Lauriala, 1992; O'Brien, 1992). In the foreword to Guskey and Huberman's (1995) book titled *Professional Development in Education: New Paradigms and Practices*, Miles notes that most of what passes as professional development is:

> Everything that a learning environment shouldn't be: radically underresourced, brief, not sustained, designed for "one size fits all," imposed rather than owned, lacking any intellectual coherence, treated as a special add-on event rather than as part of a natural process, and tapped in the constraints of the bureaucratic system we have come to call "school." In short, it's pedagogically naive, a demeaning exercise that often leaves its participants more cynical and no more knowledgeable, skilled, or committed than before. (p. vii)

Despite the criticisms, however, it appears that staff development is firmly entrenched in the educational system:

> The system of professional development is deeply institutionalized in pattern of organization, management, and resource allocation within schools and school districts, as well as between districts and a range of providers that includes freelance consultants, intermediate and state agencies, professional associations, and universities. Moreover, the system is increasingly structured by means of federal, state, and district policies. This system is powerful, resistant to change, and well adapted to the ecology of schooling. (Sykes, 1996, p. 465-66)

While staff development is now a permanent part of most overall school programs, few would argue that there has been much improvement in the last thirty years. Some see the lack of follow-up as an inherent problem with most inservice offerings (Joyce, 1990). Little (1990) argues that the superficial nature of workshops and professional development programs is still a problem:

> Compared with the complexity, subtlety, and uncertainties of the classroom, professional development is often remarkably a low-intensity enterprise. It requires little in the way of intellectual struggle or emotional engagement and takes only superficial account of teachers' histories or circumstances. Compared with the complexity and ambiguity of the most ambitious reforms, professional development is too often substantively weak and politically marginal. (p. 148)

The call for reformed staff development practices is echoed by many (Adelman & Walking-Eagle, 1997; Borko & Putnam, 1998; Campbell, 1997; Darling-Hammond, 1996; Guskey & Huberman, 1995; Loucks-Horsley, et al., 1998; Moreno, 1998; Sparks & Hirsh, 1997). Ideas range from placing all staff development at the local school sites to encouraging teachers to implement action research plans in their own classrooms. Whatever the choice for professional development, there is widespread agreement that what is currently offered is not, for the most part, working efficiently or effectively.

Needed Research for Staff Development

Until recently little was written about how to improve staff development or how to ensure that program elements are transferred to classroom implementation. "Although there is a recognition of the importance of professional development in the context of school improvement, there is also a dearth of literature regarding the nature of successful professional development programs" (Kyle, 1995, p. 679). Veenman et al., (1994) concur:

> Reviews of literature on training indicated that little empirical attention has been devoted to the issue of training transfer. Transfer of training is defined as the degree to which knowledge and skills acquired by training are effectively applied

> in the work place of the school or classroom. For transfer to occur, trained behaviour [sic] must be generalized to the job context and maintained over a period of time on the job. (p. 304)

In spite of the consensus on the importance of professional development in meeting the mandates of the reform movement, much remains to be learned about how effectively inservice training programs are implemented (Conners, 1995; Finson, 1989; Harty & Enochs, 1985; Loucks-Horsley et al., 1998; Schifter, 1996; Stein & Wang, 1988; Yeany & Padilla, 1986). Although staff development programs are conducted in virtually every school district, there is very little evidence that they result in long-term changes in instructional practices. Almost all studies of staff development have focused on the immediate reactions of participants to the training sessions or the immediate transfer of what is learned from the workshop to the classroom (Ishler, Johnson, & Johnson, 1998). Mathison (1992) maintains that, although it is necessary to evaluate an inservice experience just following its delivery in order to provide immediate feedback for the providers, the more difficult but important task is to examine effects a staff development program has on the teacher's behavior (participant's practices).

> Three criteria that may be used to evaluate staff development programs are whether participants (a) learned what was being taught, (b) transferred what they learned to their job situations, and (c) maintained their use of the new procedures for years after the training ended. (Ishler et al., 1998, p. 273)

Basically there are few well-designed, long-term staff development studies of the extent to which participants actually transfer what is taught in staff development programs to their daily practice and how much of the innovation is maintained over a period of years. Researchers are becoming interested not only in the quality of staff development training but in the factors which enhance and impede the transfer of the behaviors post-training (Guskey & Huberman, 1995; Loucks-Horsley et al., 1998; Reys et al., 1997; Sparks & Hirsh, 1997; Showers & Joyce, 1996; Veenman et al., 1994). Suggestions for new kinds of professional development abound, but most are costly. With few empirical

studies of the long-term results of professional development efforts, it is hard to persuade school systems to invest their staff development dollars in these new ways.

Future of Staff Development

While many agree that science reform calls for more professional development, Sykes (1996) takes it one step further. "Reform of professional development and reform as professional development are the dual generative themes of the future" (p. 476). Hargreaves (1995) emphasizes that "what we want for our children, we should also want for their teachers--that schools be places of learning for both of them and that such learning be suffused with excitement, engagement, passion, challenge, creativity, and joy" (pp. 27-28). Wilson, et al. (1996) reiterate that staff development must reexamine its goals and procedures:

> Teachers will have to rethink their roles in classrooms, schools, and board rooms. Teacher educators will need to learn new ways to nurture the professional development of teachers, and policy makers may have to learn to think differently about *what it takes* to enact reform documents. Though too often forgotten, it is a lesson that has been learned in earlier reforms. (p. 475)

The National Science Education (NSE) Standards on professional development mandate the kind of reform of professional development Sykes mentions (1996). NSE Standards express a need for training teachers with less emphasis on transmission of teaching knowledge and skills and more inquiry into teaching and learning. These Standards advocate learning new science content less through lecture and reading and more through investigations and inquiry. Also called for are less separation and more integration of science and teaching knowledge. Additionally, the Standards maintain that theory and practice must now be integrated in school settings rather than dissected somewhere away from the school. The NSE states that collegial and collaborative learning should replace individual learning and that long-term coherent plans should replace fragmented, one-shot sessions. They support offering variety of professional

development activities which mix internal expertise with expertise from the outside. The new Standards submit that teachers should be supported as reflective intellectual practioners rather than treated as mere technicians. Teachers should act as producers of knowledge about teaching and as leaders who are members of a collegial community (National Research Council, 1996a). Avalos (1998) agrees:

> In contrast to assuming that teachers "lack something" professional development needs to respect and value what they know; and from that basis recognize that teacher knowledge and awareness of what is needed to improve education needs also to be widened. (p. 258)

This new kind of professional development is quite different from the conventional *updating* or *reeducating* that have been common in educational settings. Learning by this standard is never finished. The new professional development opportunities for reform agendas represent a substantial departure from teachers' prior experience, established beliefs, and present practice (Little, 1990; Wilson et al., 1996). Franke, Carpenter, Fennema, Ansell, & Behrend (1998) say that educators need to:

> . . . begin to conceptualize teacher change not as acquiring a fixed set of teaching skills or learning how to use a particular program of instruction. The kind of change we envision involves teachers changing in ways that provide a basis for continued growth and problem solving -- what we call *self-sustaining, generative change*. (p. 67)

In order to achieve this self-sustaining, generative change staff development researchers continue to refine and redirect their areas of concentration as new data emerge through ongoing studies of what works and what does not. Their hope is to identify essential components which enable the best possible transfer of teacher behavior into the classroom (and ultimately bringing about positive effects on learning).

In pursuit of targeting aspects necessary for successful staff development researchers have also begun to identify factors which impede the implementation process. After examining four projects, Pink (1989) found 12 barriers to innovation effectiveness:

1. An inadequate theory of implementation, including too little time for teachers to plan for and learn new skills and practices;
2. District tendencies toward faddism and quick-fix solutions;
3. Lack of sustained central office support and follow-through;
4. Under funding the project, or trying to do too much with too little support;
5. Attempting to manage the projects from the central office instead of developing school leadership and capacity;
6. Lack of technical assistance and other forms of intensive staff development;
7. Lack of awareness of the limitations of teacher and school administrator knowledge about how to implement the project;
8. The turnover of teachers in each school;
9. Too many competing demands or overload;
10. Failure to address the incompatibility between project requirements and existing organizational policies and structures;
11. Failure to understand and take into account site-specific differences among schools;
12. Failure to clarify and negotiate the role relationships and partnerships involving the district and the local university -- who in each case had a role, albeit unclarified, in the project.

In her study of teacher perceptions of major obstacles to teaching mathematics and science effectively, Huniker (1996) finds that lack of adequate materials, supplies, and equipment are the major concern followed closely by lack of planning time, large class sizes, not enough class time, and lack of adequate staff development. Thus it can be seen that the future of professional development will rest on the ability of program

developers to deal with factors which impede implementation of project goals as well as the capacity to integrate factors which enable long-term transfer of strategies. As Collins & Spiegel (1998) so aptly put it, "The professional development efforts should be based on what we know about professional development, teacher change, and learning, rather than constantly trying to reinvent the wheel" (p. 33).

Program Antecedents

General factors have emerged from research as enhancers of and obstacles to classroom implementation of newly learned behaviors and maintenance of those practices. This study attempted to verify existing research on essential components of staff development programs as well as explore areas that have not been well documented. Those factors which have received most attention thus far include: quality of the initial training, program follow-up training, program follow-up support, school/district support, and personal commitment.

Quality of Initial Training

This study measured teacher participants' perceptions about their initial inservice summer training program in Project LIFE. Researchers agree that the significance of appropriate initial training should not be underestimated. If teachers are taught by effective science instructional techniques (i.e. use of inquiry skills, use of process skills, providing feedback) there is often transfer of this behavior to their own classrooms (Guskey & Huberman, 1995; Loucks-Horsley et al., 1998; Reys et al., 1997; Sparks & Hirsh, 1997). "The degree of satisfaction with inservice training contributes to the impact of training at the classroom level" (Conners, 1995, p. 10). Teaching behavior has been reported to have changed in teachers who received training from an instructor who modeled such skills with them (Yeany & Padilla, 1986). Jones and Lowe (1990) agree, "An important principle to be followed in professional

development sessions is that participants wind up *doing* something important, not simply hearing about it" (p. 10). Lieberman (1995) reflects that:

> What everyone appears to want for students -- a wide array of learning opportunities that engage students in experiencing, creating, and solving real problems, using their own experiences, and working with others -- is for some reason denied to teachers when they are the learners. (p. 591)

The National Research Council (1996b) notes that teachers must be trained with ways in which they learn science " . . .through inquiry, having the same opportunities as their students will have to develop understanding" (p. 60). O'Brien (1992) supports inservice training which is more participant-centered, "Although adults may be conditioned to more traditional pedagogy, transfer of training to the job site requires attention to helping the learner learn 'how to learn' rather than merely transmitting content" (p. 422). Guidelines from the National Science Foundation (1998) state:

> Professional development programs must allow teachers to see and experience good science teaching firsthand . . . Professional development programs must be led by teams that include members with scientific expertise and must incorporate activities that model the kinds of effective science teaching and learning that is expected to take place in classrooms. (p. 2)

In a study of teachers' perceptions of most important elements of professional development Nesbit, Wallace, Miller, and DiBiase (1998) find that overwhelmingly teachers list their priorities for inservice training as learning content and pedagogy. Other researchers have observed the same results; teachers are in need of technical assistance in both content and pedagogy (Haney et al., 1996; Loucks-Horsley et al., 1998; Mathison, 1992; McLaughlin, 1990; Reys et al., 1997; Sparks & Hirsh, 1997).

O'Brien (1992) contends that good training experiences build a sense of community and a shared responsibility for the teaching/learning process. He suggests that participants should be involved in questioning, risk-taking, experimentation, and collaborative problem solving. He maintains that having teachers share their own ideas,

activities, and resources builds a support network, and that ongoing follow-up helps maintain the level of interest.

Most researchers still support using the training model of workshops as a valid tool for setting agendas, laying groundwork, modeling and practicing the process of science, building community and initiating patterns of communication (Calabi, 1997). The workshop session can serve as a diagnostic/ prescriptive phase in which to build teachers' awareness of a need for change (O'Brien, 1992). Jones and Lowe (1990) add that inservice must address individual teacher needs, and theory must be tempered with relevance. However, there is almost universal agreement that quality inservice instruction alone will not guarantee real systemic change. Researchers are looking to other mechanisms for supporting and sustaining instructional strategy changes.

Program Follow-up

Studies on staff development are rich with assessments of the perceptions of participants immediately following their initial training experience. Jones and Lowe (1990) state that effective staff development requires more than just an exit instrument. They suggest that there needs to be an *impact evaluation*, which determines not simply whether participants enjoyed particular activities, but what difference these activities made in their classrooms. The instrument in this study surveyed participant attitudes and practices as many as seven years and not fewer than one year after their initial training experience. It was anticipated that the follow-up training and support from the program helped maintain implementation of their new practices.

Anderson (1998) states that by itself, even a quality inservice training activity is not adequate to sustain long-term maintenance of newly learned behaviors. One method of continuing the growth process is follow-up training after teachers have returned to their classrooms. Critics of contemporary staff development agree that too many

professional development models offer workshops as their sole program component. "Workshops by themselves are not adequate to accomplish a sustained innovation of the sort we are advocating" (Calabi, 1997, p. 3). Jones and Lowe (1990) concur:

> Staff development that is successful in changing teacher practice is a continuing process. This process may include workshops, independent study, teacher rap sessions, curriculum development, work sessions, peer observation, and self-assessment. But it is not a single activity that is accomplished in a day or even a week. (p. 8)

Ingvarson (1998) asserts that objectives of teacher enhancement programs are rarely attained by means of short, one-time in-service education courses. The National Science Foundation (1998) says that professional development programs should provide training over a long period of time.

Educational reform must be addressed in the framework of changes happening at the school settings In order for it to be participatory, inservice training should be closely connected to participants' experiences in their own classrooms (Sparks, 1994). Training must be ongoing, regular, and connected to actual classroom context (Anderson, 1990; Sparks & Hirsh, 1997; Fullan, 1995). Little (1993) believes that additional training after teachers have returned to the work place increases the possibility that content and context might be more closely joined.

For this study Project LIFE participants were asked to rate the follow-up component of their inservice experience. Their perceptions about the program's follow-up elements were compared to the findings of recent research on this staff development component.

Program Support

The National Staff Development Council (1998) recommends that professional development programs provide the support necessary to ensure improvement in teaching practices. Mathison agrees, "Too often, evaluations of inservice education are defined

primarily by the inservice experience with little, if any, resources allocated to longer term effects and change" (1992, p. 259).

In a study of science and mathematics teachers, Nesbit et al. (1998) report that teachers regard receiving materials and support from the project staff as additional essential elements to the success of the inservice experience. Moreno (1998) agrees that support is important:

> Perhaps the greatest short-coming of many staff development programs is a lack of follow-up, feedback, and ongoing assessment. . . . There needs to be time for feedback where teachers can discuss the successes and failures they've experienced since the staff development day. (p. 18)

Gibbons et al. (1997) assert that professional development programs must have an implementation component to assure that new behaviors are seen in the classroom. According to Ball (1996), "The most effective professional development model is thought to involve follow-up activities, usually in the form of long-term support, coaching in teachers' classrooms, or ongoing interaction with colleagues" (pp. 501-502). Jones and Lowe (1990) conclude:

> Staff development should involve examining assumptions about teaching, learning, and the subject matter under discussion; investigating the appropriate research base; and exploring ways to transfer insights derived from research into classroom practice. It necessitates practice with new techniques, strategies, methods, and approaches with feedback in a non-threatening environment. (p. 8)

The National Staff Development Council (1998, p. 1) recommends that professional development is done in a way that "provides for the three phases of the change process: initiation, implementation, and institutionalization." A feature of the Project LIFE program was its support components designed to help participants with the second two steps of the change process. Participants in this study were asked about their perceptions of the importance of the support they received from the program once they returned to their classrooms.

School/District Support

Researchers agree that reinforcement from the staff development program is vital to the transfer of newly acquired practices; they also concur that additional support is needed from local schools and districts to sustain desired behavior changes (Ingvarson, 1998; Little, 1990; Showers & Joyce, 1996; Stein & Wang, 1988; Veenman et al., 1994; Wilson et al., 1996). The National Science Foundation clearly reiterates that teaching practices promoted in professional development need to be supported by district and school administrators (1998). In accord with this premise, McBride, Reed, and Dollar (1994) report that school/district support emerged as an important issue among the teacher participants they studied. Hargreaves believes that in the past educational change has faltered because, among other reasons,

> The change is poorly resourced or resources are withdrawn once the first flush of innovation is over. There is not enough money for materials or time for teachers to plan. The change is built on the backs of teachers who cannot bear it for long without additional support. (1997, p. viii)

Darling-Hammond and McLaughlin (1995) agree that ongoing change in teachers' growth processes can only be accomplished with sustained commitment to building an infrastructure for reform which includes political entities at both the school and district level. Haney et al. substantiated this thesis in 1996, when their study found that teachers believe barriers such as lack of effective staff development opportunities, available resources, administrative organization support, and other factors impede their ability to implement educational reform. Fullan and Miles write that change demands school/district support :

> Change demands additional resources for training, for substitutes, for new materials, for new space, and above all, for time. Change is "resource hungry" because of what it represents -- developing solutions to complex problems, learning new skills, arriving at new insights, all carried out in a social setting already overloaded with demands. (1992, p. 751)

Kober (1993) enumerates important assistance that teachers need from schools and districts in order to implement changed practices:

> . . . The research literature makes clear that the benefits of staff development are unlikely to be sustained unless schools become learning organizations in which good teaching can flourish. This means providing teachers with sufficient resources and materials, providing release time for teacher learning activities and student field trips, promoting collegiality, giving teachers more decision-making authority in school processes, and addressing logistical issues such as scheduling and classroom organization. (p. 66)

Specific to reform-based instructional strategies in science are findings that teachers perceived barriers impeding implementation of their capacity to provide quality science instruction to be a lack of planning time, inadequate resources, and the perception that science was not valued as highly a mathematics (Huniker, 1996).

Reports about Project LIFE did not list administrative support from local and/or district levels as a strength of the staff development program (McGee, 1998; Radford, 1998; Radford et al., 1998). The survey instrument for this study was designed to include teacher participants' perceptions about reinforcement at the administrative level. These data were compared to other program factors as well as to teachers' overall use of reform-based science instructional strategies to help determine if school and district support is a major factor in transfer and maintenance of newly learned practices.

School reform advocates support a professional development system that is collaborative and based on a learning community among teachers (Anderson, 1998; Borko & Putman, 1998; Ingvarson, 1998; Lieberman, 1995; Little, 1990). They contend that teachers need the support of their peers as they attempt new instructional strategies. Yeany and Padilla (1986) reviewed 24 studies of effects of science inservice programs; they found that programs that had peer or supervisory feedback were three times as effective as those which did not. Likewise, Little found that reciprocal feedback among teachers had a substantial positive impact on implementation (1990). Wilson et al. (1996) reporting on work with mathematics teachers in California learned

that, "while teachers might want new materials, they really needed ongoing professional opportunities to talk about their practice" (p. 470).

In Paraguay educators are experimenting with "learning circles" or workshop structures that involve teachers and trainers in school clusters or in a single school setting (Avalos, 1998). Conners (1995) supports having strong collegial staffs. He states that implementation of staff development programs is more successful in schools where there is continuous interaction between staff at all levels.

Showers and Joyce (1996) recommend that peer coaching must be a part of the overall plan to increase teacher transfer of training into the classroom. They do not believe that peer coaching is an end unto itself, but rather it must operate within the overall school improvement initiative. They believe that the study of teaching and curriculum must be the focus of effective collegial collaboration.

In their Urban Elementary Outreach Program, Gibbons et al. (1997) noted immediate improvement in their model when they switched to allowing teachers to pool resources and offer each other support. Program planners noted that teachers needed collegial support in order to bolster their self-efficacy.

Schmoker (1997) advocates members of a staff coming together to discuss instruction and its improvement with serious · ·arity:

> It is important to realize as well that a well-planned goal-oriented effort almost always pays off in the near term. When people work collectively toward shared, measurable goals, and when they regularly share practical expertise in a mutually accountable setting, short-term improvement is almost inevitable. And the effect of seeing these measurable, visible improvements, however slight, is perhaps the most underestimated step we could take to promote higher levels of both staff expertise and student learning. (p. 145)

Darling-Hammond and McLaughlin (1995) concur that, "Professional development today means providing occasions for teachers to reflect critically on their practice and to fashion new knowledge and beliefs about content, pedagogy, and

learners" (p. 597). They assert that this kind of learning enables teachers to make the leap from theory to accomplished practice.

In the context of overwhelming research that suggests collegiality among teacher peers improves the positive transfer and maintenance of newly learned behavioral practices, this study looked at teacher participant perceptions about their own collegiality and its effect on the level of their reform-based instructional strategy implementation. Data from survey questions dealing with peer support were combined with other program factors in the area of school/district support.

Personal Commitment

A final factor that research indicates plays a major role in actual classroom implementation and maintenance of newly learned practices is that of teacher attitudes. Acquarelli & Mumme (1996) point out that beliefs and behaviors are part of a reciprocal process. They say that critical examination of one's belief system encourages one to rethink actions, and behavior provides the grist for the examination of one's beliefs. Haney et al. (1996) find considerable evidence in their research that teacher beliefs are significant contributors of behavioral intention. They state:

> The obstacles and enablers that the teac[illegible] were provided mattered less to them than did their beliefs about the positiv[illegible]l negative outcomes associated with the behavior. This finding suggests t[illegible]eacher training should pay particular attention to the attitudes teachers have toward behavior before alterations of the control factors (such as providing curriculum materials, reducing class size, including flexible class scheduling, etc.) are expected to lead to lasting changes in classroom practice. It was, therefore, concluded that it is unlikely that top-down, teacher-proof models for science inservice experiences (ones that provide teachers with all the needed resources without attending to teacher belief factors) would be successful. (p. 985)

Bradley agrees that if a teacher is positive towards the staff development program, then the chances are better for bringing about change. If the teacher is negative towards the staff development program, there is little likelihood the strategies will be adopted (1991).

In the early 1970s, the Research and Development Center for Teacher Education at the University of Texas-Austin began studying the roles of teacher concerns. Their Concerns-Based Adoption Model (CBAM) reports that change is a highly personal experience where teacher perceptions and feelings are at least as important as the innovation's trappings and technology (Horde, Rutherford, Huling-Austin, & Hall, 1987). Other researchers have agreed that teachers' commitment is inherent to positive change in practice (Lauriala, 1992; Little, 1993; McGinnis, Kramer, Roth-McDuffie, & Watanabe, 1998; Ross, 1994; Stein & Wang, 1988; Wilson et. al., 1996).

Stein and Wang (1988) voice the concern that very little attention has been given to the idea that just because teachers are *able* to implement a specific innovation does not necessarily mean that they are *motivated* to do so. As Meier states, "The secret ingredient is wanting it badly enough" (1994, p. 185). Schmoker sums it up effectively, "Even after we have all the elements in place, commitment is everything" (1997, p. 146).

In summary it can be seen that staff development over the years has shown a shift in both its methodology and purpose. Researchers generally agree that teacher participants should be taught in ways that program designers hope participants will eventually teach their own students. A review of literature suggests that essential components of effective professional development programs must include attention to the areas of: initial inservice training, program follow-up, program support, school/district support, and teacher participants' personal commitment to the program's goals.

CHAPTER III

RESEARCH METHODOLOGY

The purpose of this study was two-fold: 1) to determine whether or not there were significant differences in implementation levels of reform strategies by teachers who participated in an established staff development program, Project LIFE, and those who did not, and 2) to distinguish specific program factors that may have impacted the level of implementation of reform-based instructional classroom. The investigation was in two parts. Part one was a study of the self-reported reform-based levels of implementation of Project LIFE participants as compared to non-Project LIFE participants. Part two examined the perceptions of Project LIFE participants about their experience with the program's staff development factors to determine if there was an influence of particular factors on transfer of training to classroom practices.

Research Design for Hypothesis One

The first hypothesis guiding this study was: 1) Project LIFE, an established science staff development program, produced a higher level of implementation of reform-based science instructional practices in the classrooms of its participants as compared to a similar group of non-Project LIFE science teachers. This hypothesis was tested using a quasi-experimental design which compared self-reported levels of implementation of reform-based instructional classroom practices between an experimental group of Project LIFE participants and a control group of non-Project LIFE science teachers.

Population and Sample for Hypothesis One

Experimental Group

Approximately 200 teachers from Arkansas, Louisiana, and Texas participated in Louisiana Tech University's Project LIFE Staff Development Program during one of the program years between 1992-1998. Teacher participants from the seven Project LIFE Program groups were mailed the Survey *of Research-Based Science Teachers Training (SRBSTS)* instrument. (See Appendix B). The return rate from Project LIFE teachers was 74 percent or 148 surveys. All returned surveys were usable.

Control Group

Control group members were drawn from non-Project LIFE science teachers who attended the 1999 West Virginia Middle Level Educators Conference, teachers who teach in Lincoln and contiguous parishes in Louisiana, and science teachers from across the United States whose principals volunteered their faculties to participate in the survey by providing demographic information and present levels of implementation of reform-based science teaching strategies in their classrooms. Of the 70 surveys distributed, 43 were returned. Of the 43 surveys, nine were unusable because respondents either did not follow directions, or they provided self-contradictory answer combinations. This left a control group sample of 34 subjects.

Experimental Group Sample

Because of the disproportionate number of members in the experimental group (n= 148) as compared to the control group (n=34), a random sample of 40 Project LIFE teachers was chosen from the 148 subjects who returned surveys. This was done to satisfy the assumptions associated with the independent t-test, that is for one sample size not to be more than twice the size of the other sample (Popham, 1993). A comparison

of the reported levels of implementation of reform-based instructional strategies between the sample Project LIFE teacher participant population and the non-Project LIFE teachers was made.

Instrumentation

This study investigated teacher perceptions of staff development program factors that may have influenced their post-training levels of implementation of reform-based classroom practices. A comprehensive review of science education literature revealed no instrument that addressed the particular aspects of the reform-based teaching strategies required for this study. An instrument was needed that would allow respondents to report their current levels of implementation of specific strategies such as cooperative learning, learning cycle/discovery approach, hands-on/minds-on activities, science process skills, long-term science investigation, alternative assessments, multi-disciplinary instruction, writing about science, complex questioning techniques, learning logs and journals, and attention to national standards. There were instruments which measured limited areas of reform-based instructional methodologies, but none that had the comprehensive list required for this research. Therefore, the researcher developed an instrument with the required constructs.

Theoretical Basis for the Instrument

The reform-based instructional strategies selected for study were based on essential practices which emerged in the review of literature on the national reform movement and key methodologies stressed by the Project LIFE Program. The theoretical basis for the survey of implementation section of the instrument was based largely on works of Ishler et al., 1998; the American Association for the Advancement of Science (AAAS), 1989, 1993, 1998; the National Research Council (NRC), 1996a; and the National Science Teachers Association (NSTA), 1992.

Instrument Development

The researcher developed an instrument, the *Survey of Reform-Based Science Teacher Training (SRBSTT),* which included a section, Part G, for measuring reported levels of implementation of the instructional strategies being tested. The data from this section constituted the dependent variable for this study. The *SRBSTT* instrument was patterned after a survey developed and tested by A. L. Ishler, R. T. Johnson, and D. W. Johnson (Ishler et al., 1998). Respondents were asked to respond to items about the percent of time spent on science reform- and non-reform-based instructional strategies (n=15 items). They were able to choose from among six responses. There were five equal interval scales which ranged from "81% - 100%" to "1% to 20%" and one category for "no time at all" for each item.

The entire instrument is discussed later in this chapter, but for Project LIFE respondents, Part G of the *SRBSTT,* which measured levels of implementation of reform-based strategies, was used for this component of the study, and the short form of the *SRBSTT* was used for non-Project LIFE teachers (control group). In the final revision both instruments contained identical items; the revised instruments are in Appendix B and Appendix C, respectively.

A demographic data collection sheet (Appendix A) was attached as part of the *SRBSTT.* Information pertaining to the program year of participation, age, gender, ethnicity, length of teaching experience, current position, description of the school setting, college major, college minor, and program residential status was collected. Non-Project LIFE respondents were asked to supply the same demographic information as the Project LIFE participants.

The complete *SRBSTT* instrument given to Project LIFE participants was composed of nine sections: demographic information, Part A- initial program inservice training (10 items), Part B- follow-up from the program (5 items), Part C- support from

the program (4 items), Part D- school/district support (10 items), Part E- commitment to science reform-based instructional practices (7 items), Part F- importance of additional program factors (4 items), and Part G- percent of time spent on science reform and non-reform-based instructional practices (15 items).

For Parts A - F, subjects were asked to respond to 40 items in six subcategories of factors regarding their Project LIFE staff development program experience. The four items in Factor F dealt with other Project LIFE program factors. They were not intended for use in this particular study. Only the 36 items in the five subcategories (A, B, C, D, and E) were used for this investigation. For Part G, subjects selected time intervals corresponding to the amount of time spent on instructional strategies.

All items (except for Part G) required answers on a Likert-type scale (6= strongly agree, 5= agree, 4= tendency to agree, 3= tendency to disagree, 2= disagree, 1= strongly disagree). Programming was used to convert scales on items that were reversed so that in the computed data "6" always represented the most desired response and "1" represented the least desired response.

The final part of the survey consisted of six open-ended questions designed to encourage respondents to compare their teaching prior to Project LIFE training to post-Project LIFE training, to elaborate on what helped them to implement the reform-based practices when they returned to their classrooms, and to suggest improvements for future staff development training.

Factor Analysis

According to Gay (1981) a satisfactory way of dealing with several items within a variable is to form subgroups among the items to ascertain if there is an underlying structure in the data matrix. Hair, Anderson, Tatham, and Black (1995) recommend using factor analysis of variance to address the problem of analyzing the structure of the

interrelationships (correlation) among a large number of variables by defining a set of common underlying dimensions, known as factors. For the dependent variable, reported levels of implementation of reform-based instructional practices in the classroom, teacher participants indicated their current levels of implementation for 15 items related to use of reform-based and non-reform-based practices in subcategory G. A factor analytic technique was used to condense the information contained in the original 15 variables into a smaller set of new, composite dimensions with a minimum loss of information.

The first objective was to make an identification of the underlying dimensions or factors ends in themselves; the estimates of the factors and the contributions of each variable to the factors (termed loadings) were determined. A loading of 0.3 or more is frequently taken as meaningful (Kline, 1994), but for purposes of this research a loading of 0.4 or more was used. Table 1 shows that all 15 factors loaded at 0.4 or higher.

Table 1 Communalities for Factor G (Levels of Implementation)

Item	Initial	Extraction
Cooperative Learning	1.00	.572
Learning Cycle Approach	1.00	.666
Reading from Text	1.00	.639
Hands-on/Minds-on	1.00	.714
Science Process Skills	1.00	.668
Factual Recall	1.00	.661
Alternative Assessments	1.00	.585
Multi-disciplinary Instruction	1.00	.820
Writing About Science	1.00	.552
Drill & Practice	1.00	.677
Long-term Investigations	1.00	.415
Complex Questioning	1.00	.409
Standards & Benchmarks	1.00	.434
Learning Logs & Journals	1.00	.469
Direct Teaching/Lecture	1.00	.756

Extraction Method: Principal Component Analysis

The second objective required that estimates of the factors themselves (factor scores) be obtained and used to consider the conceptual underpinnings of the variables. The component matrix in Table 2 shows that 10 of 15 items which referred to implementations of reform-based instructional practices (*Cooperative Learning, Learning Cycle/Discovery Approach, Hands-on/Minds-on, Science Process Skills, Alternative Assessments, Writing About Science, Long-term Science Investigations, Complex Questioning Techniques, Attention to National Standards & Benchmarks, Learning Logs/ Journals*) factored into one variable.

Four of the 15 items in Part G referred to non-reform-based teaching strategies (*Reading from the Textbook, Factual Recall, Drill and Practice, and Direct Teaching/Lecture*); these four components loaded highest for a second variable extraction and were not used in computing the respondent's score for Factor G because the first extraction satisfied the need for one factor score which represented reform-based instructional practices.

The third factor in the component matrix showed only one item, multi-disciplinary instruction, which loaded highest, and therefore, that item was not included in the Factor G listing. The items in the first extraction composed 36 percent of the variance. The items in the second extraction and third extraction composed an additional 18 percent and 7 percent. It was determined that only the items which loaded in the first extraction of the component matrix needed to be used. Table 2 presents the data used for this analysis.

Table 2 Component Extraction Matrix

	1[a]	2[a]	3[a]
Cooperative Learning	.752	-1.718E-03	-7.753E-02
Learning Cycle Approach	.809	-2.309E-03	-.107
Reading from Text	-.313	.712	-.183
Hands-on/Minds-on	.837	5.917E-03	-.119
Science Process Skills	.800	.144	-8.708E-02
Factual Recall	-.383	.715	-4.920E-02
Alternative Assessments	.703	.301	-1.008E-02
Multi-disciplinary Instruc.	-2.943E-02	3.464E-02	.905
Writing About Science	.515	.520	.128
Drill & Practice	-.382	.717	-.129
Long-term Investigations	.608	.190	-9.842E-02

(table continues)

Table 2 *(continued)*

	1[a]	2[a]	3[a]
Complex Questioning	.624	.106	8.983E-02
Standards & Benchmarks	.494	.297	.320
Learning Logs & Journals	.555	.391	8.882E-02
Direct Teaching/Lecture	-.561	.660	8.398E-02

Extraction Method: Principal Component Analysis.
[a]3 components extracted.

Validating the Instrument

The preliminary *SRBSTT* was mailed to six nationally distinguished science education and staff development experts across the United States. Critiques and suggestions for improvement were received from Dr. Shelley Fones, Professor at Clemson University; Dr. Carl Frantz, Director Research and Sponsored Programs at the University of Southwestern Louisiana; Stephanie Hirsch, Associate Executive Director of the National Staff Development Council; Dr. Duane Inman, Associate Professor at the University of Memphis; and Dr. Mary Jo McGee-Brown, former Professor at the University of Georgia and currently an independent consultant for program evaluation of projects across the United States and Canada. The experts agreed that the survey measured the important tenets of reform-based science teaching. It was believed that the *SRBSTT* measured valid content-related constructs.

The comments from the experts about the instrument were of a similar nature and were utilized to improve it. Their suggestions centered mainly on sentence structure of the Likert-type scale items, and their ideas were incorporated into the revised survey. Additional adjustments and questionnaire items proposed by the experts were integrated into the final survey form. Appendix B contains the complete revised survey instrument.

Procedural Details for Hypothesis One

The researcher followed the recommendations for a self-administered questionnaire (Babbie, 1997) to ensure that a high rate of surveys was returned. To gather the data, the *Survey of Reform-Based Science Teaching Training (SRBSTT)*, a cover letter explaining the purpose of the study and the anonymity of responses, and a reply postcard were mailed to all former Project LIFE teacher participants (n=200) for whom there was a known address (addresses were known for all but four former participants). Respondents voluntarily mailed anonymous questionnaires and data sheets to the researcher. Because of the high rate of return after the first mailing, no further contact was made with Project LIFE respondents.

Non-project LIFE participants were given a short form of the *SRBSTT* and directions for responding by the researcher, by a colleague of the researcher, or by the administrator of the targeted respondents. Respondents voluntarily gave or mailed anonymous questionnaires and data sheets to the researcher.

The criterion for inclusion of a returned survey was that the respondent 1) followed directions, and 2) gave no self-contradictory response patterns (i.e. if the respondent indicated that he/she spent "81% to 100%" of instructional time using hands-on/minds-on activities, and he/she also indicated that he/she spent "61% to 80%" of instructional time using direct instruction/lecture, this would constitute a self-contradictory response pattern).

An independent samples t-test analysis was used to compare the means of reported levels of implementation (dependent variable) of reform-based science teaching practices between the experimental and control group in order to test the hypothesis that Project LIFE positively affected the level of implementation of reform-based instructional practices by science teachers in their classrooms. The conventional level of significance of $p < .05$ was chosen.

Research Design for Hypothesis Two

The hypothesis guiding the second part of the research design was: Teacher perceptions of staff development program factors of initial training, project follow-up, project support, school/district support, and commitment to the value of the program's goals significantly predict a positive level of implementation of reform-based instructional practices by Project LIFE teachers. This area of investigation followed an ex post factor (causal-comparative) research method. Through regression analysis between reported levels of implementation (dependent variable) and five subcategories of independent variables in the study of 148 Project LIFE participants, a determination was made about teacher perceptions as to which factors seemed to have the greatest influence on subsequent levels of implementation of reform-based science instructional practices in the classroom.

Population and Sample for Hypothesis Two

Teacher participants from the seven Project LIFE Program groups were mailed the survey *of Research-Based Science Teachers Training (SRBSTS)* instrument which solicited data for hypothesis two. As reported earlier, 148 of the possible 200 former Project LIFE participants mailed back completed surveys. All returned surveys were used and represented 74 percent of the entire Project LIFE teacher participant population. Demographics for the group are presented in Tables 4 and 5 in Chapter 4.

Theoretical Basis for Hypothesis Two

The major staff development program factors selected for study were based on essential components which emerged in the review of literature. The theoretical basis for the instrument was based largely on works by Guskey and Huberman (1995), the National Staff Development Council (1998), Sparks & Hirsch (1997), The National Institute for Science Education (Loucks-Horsley, et al., 1998), and the Concerns-Based

Adoption Model (CBAM) from the University of Texas (Horde et al., 1987). Items were crafted around five constructs to measure teacher perceptions about staff development program factors. Those major areas included: initial training, program follow-up, program support, school/district support, and commitment to the program's values.

Theoretical Model for Hypothesis Two

Figure 1 shows the theoretical model for the second hypothesis. It was hypothesized that the five constructs derived from a review of literature: initial training, program follow-up, program support, school/district support, and commitment to the program's values would have equal impact on post-training levels of implementation.

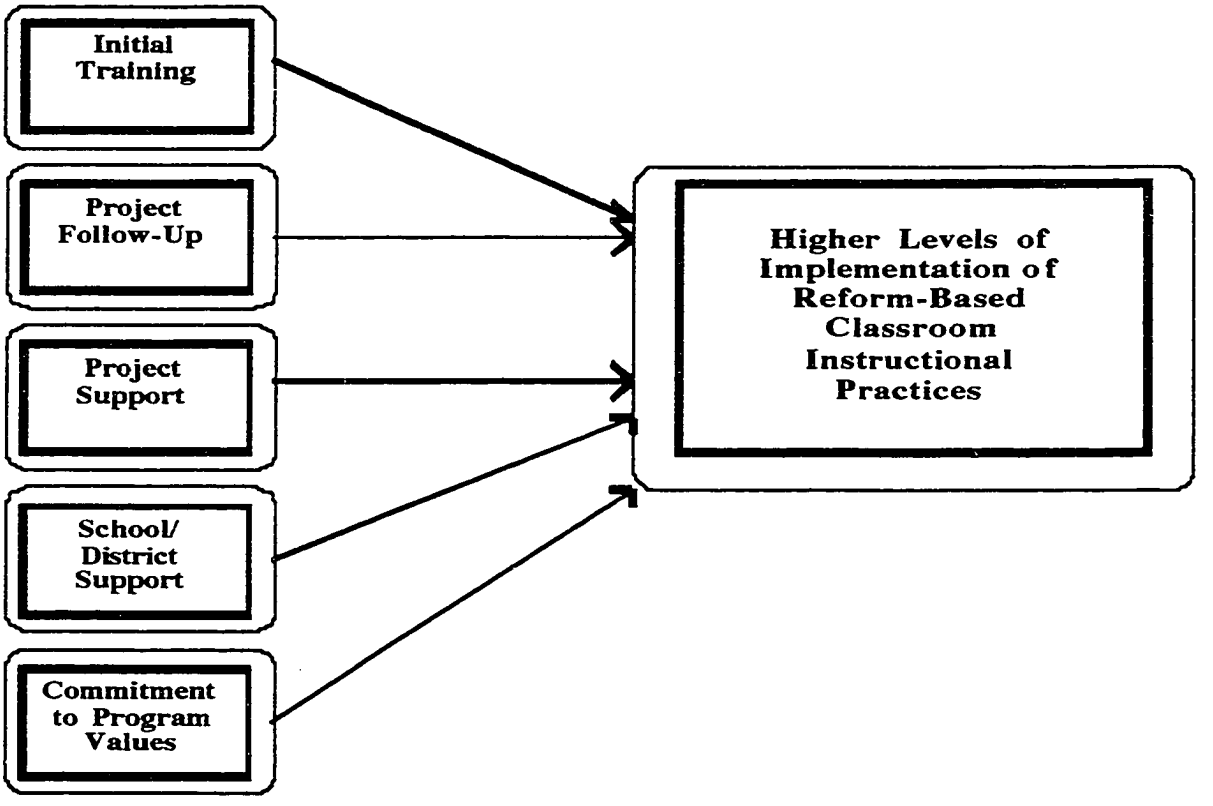

Figure 1 . Theoretical Model for Hypothesis Two

Determining Reliability of the Instrument

A Cronbach Alpha (Cronbach, 1951) test for reliability was determined on the items within each of the six investigated subcategories (A, B, C, D, E, and G) to establish the internal consistency within and among each of the six subcategories on the instrument. According to Hair et al. (1995) a commonly used threshold value for acceptable reliability is *alpha* > .70. The scores of each subcategory were, Factor A (*alpha* = .898), Factor B (*alpha* = .770), Factor C (*alpha* = .771), Factor D (*alpha* = .793), Factor E (*alpha* = .777), and Factor G (*alpha* = .881). The overall instrument reliability was (*alpha* = .912). All scores were within acceptable ranges for statistically significant reliability. Table 3 shows the results of the tests for reliability.

Table 3 Reliability Analysis Scale

Factor	Number of	Reliability
Factor A- Initial Training	10	.898
Factor B- Project Follow-up	3	.770
Factor C- Project Support	5	.770
Factor D- School/District Support	9	.793
Factor E- Commitment to Program Values	7	.776
Factor G- Levels of Implementation	10	.881
Factors A-B-C-D-E & G	44	.912

Procedural Details for Hypothesis Two

The method for mailing and receiving the *SRBSTT* has been previously discussed in regard to hypothesis one. For the experimental group the four-page *SRBSTT* constituted the entire measuring instrument and was used to collect data for both hypothesis one and hypothesis two.

Instrumentation

Factor Analysis

For both hypotheses all data were entered and analyzed through an SPSS® computer program (SPSS, 1998). The question inferred by hypothesis two is "which program factors can be used to predict levels of implementation of reform-based practices in the classroom?" In order to answer this question it was necessary to compare the five groups of staff development program factor subcategories, the independent variables, with the levels of implementation of reform-based instructional practices, the dependent variable.

It was found that most items in the subcategories of the survey instrument were additive. Each section of the survey was factor analyzed. The principle component method was used to extract a single factor variable for all items which loaded into each subcategory. A loading of 0.4 or more was used for the purpose of data reduction. The procedure for computing Factor G was presented in this chapter's discussion of hypothesis one. Factors A - E were similarly computed.

The first independent variable tested was the teacher participants' perceptions about the quality and quantity of their initial program training experience in Project LIFE. Respondents indicated agreement or disagreement on a six-point Likert scale for ten items dealing with sufficient modeling by the program staff and being given

adequate time, discussion, and practice for acquiring the knowledge and skills necessary to implement science teaching reform strategies. All ten items for the subcategory Factor A, perceptions of initial training experience, loaded at 0.4 or higher. All were reduced to a single factor variable.

The second independent variable tested teacher participants' perceptions about quality and quantity of follow-up training provided by the Project LIFE staff. Respondents indicated agreement or disagreement on a six-point Likert scale for five items dealing with additional time and opportunities for reinforcement of program objectives provided by the project staff. Four of the five items for the subcategory Factor B, perceptions of project follow-up, loaded at 0.4 or higher. Item B14, *opportunities to visit other participants' classrooms*, was not included in the single factor variable.

The third independent variable tested was teacher participants' peceptions about quality and quantity of follow-up support provided by the Project LIFE Program. Respondents indicated agreement or disagreement on a six point Likert-type scale for four items dealing with assistance from the project staff and resources for implementing program objectives. All of the four items for the subcategory Factor C, perceptions of project support, loaded at 0.4 or higher. All were reduced to a single factor variable.

The fourth independent variable tested was teacher participants' perceptions about quality and quantity of support from their schools and districts in implementing reform-based science teaching strategies. Respondents indicated agreement or disagreement on a six-point Likert scale for ten items addressing district and school assistance and support. Nine of the ten items for subcategory Factor D, perceptions of school/district support, loaded at 0.4 or higher. Item D28, *too many competing demands interfere with implementation of reform-based science strategies,* was not included in the single factor variable.

The fifth independent variable tested was teacher participants' perceived value of the propram goals. Respondents indicated agreement or disagreement on a six-point Likert scale for seven items addressing their belief in and commitment to reform teaching ideals. Seven of the seven items for subcategory Factor E, perceptions of program values, loaded at 0.4 or higher and were reduced to a single factor variable.

Multiple Regression Analysis

Multiple regression is the appropriate method of analysis when the research problem involves a single dependent variable presumed to be related to one or more independent variables. The objective of multiple regression analysis is to predict the changes in the dependent variable in response to changes in the several independent variables (Hair et al., 1995).

A stepwise multiple linear regression analysis was used to determine the significance of the relationships between the independent variables (Factors A, B, C, D, E) and the dependent variable (Factor G) in the study of 148 Project LIFE participants. The conventional level of significance $p < .05$ was chosen. This process was used to identify the independent variables which appeared to mediate the positive level of implementation of reform-based science teaching practices in the classroom levels of implementation of reform-based science instructional strategies in the classroom.

A Pearson product-moment correlation coefficient was used to measure inter- and intra- item relationships on the *SRBSTT*. The results of this analysis and a discussion of these relationships can be found in Table 13 in Chapter Four.

Responses to Open-Ended Questions

Qualitative data from open-ended questions were considered in relation to the findings from the quantitative data. As expected some subjects answered every question, some answered only one or two questions, and some answered none. Data

from responses were tabulated for frequency of occurrence and examined for emerging patterns of thought from respondents. Data related to Short Answer Question 3 regarding program motivators and other perquisites were not intended for use in this study and will be examined at a future time.

Summary

The *SRBSTT* was shown to be a content-related valid and reliable survey instrument that could be used to measure levels of implementation of program objectives subsequent to a staff development program. Factor analysis showed that all or most items in each category were highly related and that categories showed a strong intra-correlation.

In order to test the first hypothesis that Project LIFE positively affected the level of implementation of reform-based instructional practices by science teachers in their classrooms, Subcategory G was used as the dependent variable. An independent samples t-test analysis was done to compare the reported mean levels of implementation of reform-based science teaching strategies between an experimental random sample population of 40 Project LIFE teacher participants and a control group sample of 34 non-Project LIFE teachers.

The complete instrument was used with the 148 of 200 Project LIFE teacher participants from program years 1992-1998 and from a three-state area who responded to the survey. An examination was made comparing their perceptions of five staff development program components to their subsequent levels of implementation of reform-based teaching practices in their classrooms. A multiple regression analysis was used to identify the independent variables which appeared to predict the positive level of implementation of reform-based science teaching practices in the classroom.

CHAPTER IV

DATA PRESENTATION AND ANALYSIS

Overview

The purpose of this chapter is to present an analysis of data with respect to 1) levels of implementation of reform-based science instructional practices in the classrooms of Project LIFE and non-Project LIFE teachers and 2) the relationship between Project LIFE teacher perceptions of five areas of staff development program factors and their post-training levels of implementation of reform-based science instructional practices in the classroom. The data are presented as they pertain to the two hypotheses as restated below:

1. Project LIFE, an established science staff development program, influenced a higher level of implementation of reform-based science instructional practices in the classrooms of its participants as compared to a similar group of non-Project LIFE science teachers.
2. Teacher perceptions of staff development program factors of initial training, project follow-up, project support, school/district support, and commitment to the value of the program's goals significantly predict a positive level of implementation of reform-based instructional practices in Project LIFE classrooms.

Qualitative results from the open-ended question part of the *SRBSTT* are presented for both constructs.

Population and Sample for Hypothesis One

Experimental Group

The return rate from Project LIFE teachers was 74 percent. Of the 200 surveys mailed to former teacher participants, 148 were completed and returned. Surveys were returned from participants in all seven program years, 1992-1998. Table 4 shows the demographic mean age of the group returning surveys was M=43. The average teaching experience was M=14 years. Those returning surveys reflected the average Project LIFE teacher as well as the national average for teachers in general. Table 5 shows that seventy-one percent of the respondents were white females. The group was composed of 18 black females, 105 white females, 20 white males, and three females who indicated *other* ethnicity. There were two participants who did not indicate gender or ethnicity.

Control Group

Of the 70 surveys distributed to non-Project LIFE teachers, 43 were returned. There were 34 usable surveys for the control group. The data shown in Table 4 show that the mean age of the control group was M= 42, and the average teaching experience level was M= 14 years. As shown in Table 5 this group was composed of 7 black females, 1 black male, 19 white females, and 7 white males The experimental and the control groups matched closely in terms of age and length of teaching experience. They were somewhat similar in gender and ethnicity. The majority of both groups were currently classroom teachers in rural schools.

Table 4 Average Age and Years Teaching Experience for Each Group

	Total Usable Surveys	Mean Age in Years	Mean Teaching in Years
Project LIFE	148	42.6	14.3
Non-Project LIFE	34	42.2	14.0

Table 5 Total Numbers by Gender and Ethnicity for Each Group

Project LIFE	Females	Males	Total
Black	18	0	18
White	105	20	125
Other	03	0	03
Total	126	20	146
Non-Project LIFE	**Females**	**Males**	**Total**
Black	07	01	08
White	19	07	26
Other	0	0	0
Total	26	08	34

Comparison of Levels of Implementation Among Groups

The ten items in the single factor variable (Factor G) were summed for each respondent's level of implementation score. As shown in Table 6, Levene's Test for Equality of Variances, indicated the assumption of homogeneity of variance was not violated between the experimental and control groups, $F = .450$, $p > .05$.

Table 6 Levene's Test for Equality of Variances

Implementation of Reform-Based Strategies (Factor G)	Levene's Test for Equality of Variances	
	F	Significance
Equal Variances Assumed	.450	.504

An independent samples t-test was used to compare the reported levels of classroom implementation of reform-based science teaching strategies, as indicated on Factor G of the *SRBSTT*, between a sample population ($n = 40$) of Project LIFE teachers and the control group of non-Project LIFE science teachers ($n = 34$). The independent variable was Project LIFE or non-Project LIFE. The confidence interval was entered at .95 percent. Results shown in Table 7 indicate that the calculated t-test was significant ($t = 3.46$ with 72 *df*, and significance*[2-tailed]* is $p < .001$).

Table 7 t-Test for Equality of Means

Implementation of Reform-Based Strategies (Factor G)	T-Test			
	t	df	Sig. (2-tailed)	Mean Difference
Equal Variances Assumed	3.462	72	.001	6.08

In order to verify the results for the comparison of the control group and the experimental sample group, other group means were computed. For the 182 total

respondents M= 35.73 with a SD= 8.69. For the 148 total Project LIFE teacher respondents (composite experimental group) the mean was 36.82 with a standard deviation of 8.69. For the random sample of Project LIFE teachers (experimental group sample) the mean was 37.08 with a standard deviation of 7.94. For the 34 non-Project LIFE teachers (control group) the mean was 31.37 with a standard deviation of 6.95. Table 8 shows these results.

Table 8 Mean Level of Implementation (Factor G) for Each Group

Factor G	N	Minimum Score	Maximum Score	Mean	Std.
Levels of Implementation for All Respondents	182	18	59	35.73	8.69
Levels of Implementation for Project LIFE Teachers	148	18	59	36.82	8.69
Levels of Implementation for Random Sample of Project LIFE Teachers	40	18	50	37.08	7.94
Levels of Implementation for Non-Project LIFE Teachers	34	19	43	31.37	6.95

For the experimental group sample (n= 40) the mean score on Factor G, levels of implementation, was slightly higher than the mean for the composite experimental group (n= 148). Among all 148 Project LIFE subjects on Factor G, level of implementation M= 36.82. A t-test run between the control group and the 148 Project LIFE subjects was also significant at p< .001.

Because the differences of reported levels of implementation of reform-based classroom practices were significantly higher for Project LIFE teachers as compared to non-Project LIFE teachers, hypothesis one was confirmed.

Previous research on Project LIFE teachers (McGee-Brown, 1998; Radford, 1998) has shown that Project LIFE positively impacted teacher participant attitudes,

understanding of process skills, knowledge of science content, and teaching practices during their respective summer involvement and follow-up year of their participation. This study provided new evidence that the levels of program implementation of reform-based classroom instructional practices remained higher than those of the non-Project LIFE counterparts.

Confirming qualitative data came from the open-ended short answer response items on the *SRBSTT* instrument. Data from Item 1 (*Compare your science teaching prior to your Project LIFE inservice training to your science teaching after having been through the program*) yielded 109 out of 148 teachers who wrote something about now using instructional practices that are far more student-centered, discovery oriented, and hands-on/minds-on focused than they used before going through the Project LIFE inservice training. Quantitatively that means that 81 percent of the Project LIFE respondents wrote that they were practicing more reform-based teaching strategies now than before they went through the inservice training. In regard to cooperative learning, teachers reported an increased use since their inservice training (n= 24). Using more of an inquiry approach and less of a *recipe science* approach was also cited by respondents (n= 18). Alternative assessment was given as a major change in their teaching practices for some (n= 15) participants. Other changes mentioned by subjects (n= 10 or more) were more attention to teaching process skills, more focus on the *Big Picture*, better questioning techniques, and having more equipment and materials.

Project LIFE teachers who responded to Item 1 were entirely positive in their reflections on how their own practices improved through the program. Typical comments were of the nature of these three quotes from teachers:

- I don't think I was a science teacher before Project LIFE.
- Before I always dreaded science. Now I am in love with science . . . I love teaching it!

- Prior to LIFE I was enrolled in a course called "Conceptual Learning/Teaching." That class taught me many reform skills but did not give me the hands-on tools to implement them. Project LIFE gave me usable activities. Once I was comfortable with these, I have been able to transfer the knowledge to some of my traditional activities. This LIFE spring board has shown me how to improve and motivated me to do so.

For purposes of this study the researcher hoped to determine whether or not Project LIFE is an effective staff development program, and to what extent the findings from its participants would be important in analyzing a correlation between their perceptions of program factors and subsequent classroom practice (i.e. transfer of training). Results from the first part of this study, past research studies (McGee-Brown, 1998; Radford, 1998), and qualitative data collected on the *SRBSTT* instrument indicate that Project LIFE is an effective inservice program that produces sustained results in the classroom. Project LIFE participant perceptions of their staff development program factors are an important area of study.

Impact of Program Factors on Program Implementation

A stepwise multiple linear regression analysis was used to determine the significance of the relationships between the independent variables (Factors A, B, C, D, E) and the dependent variable (Factor G) in the study of 148 Project LIFE participants. The conventional level of significance $p < .05$ was chosen. Only one model was generated by the regression analysis. Table 9 shows that only one factor, participant commitment to program values (Factor E), could be used to predict positive levels of implementation of reform-based science instructional practices (Factor G).

Table 9 Variables Entered/Removed [a]

Model 1	Variables Entered	Method
	Commitment to Program	Stepwise (Criteria Probability-of-F-to enter <= .050. Probability-of-F-to remove >= .100).

[a] Dependent Variable: Implementation

In Table 10 the adjusted R^2 indicated that Factor E could be used to explain 19 percent of the variabiliy in positive implementation ($R^2 = .19$). The significance level for this correlation was $p < .001$.

Table 10 Model Summary of Factor E[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.473[a]	.191	.186	.8973

[a] Predictors: (Constant), Commitment to Program Values

To test the hypothesis that the amount of variance explained by the regression model (Table 10) was more than the variation explained by the average (i.e. that R^2 was greater than zero), the *F* ratio was used. In order to test the significance of the overall model, the SPSS® program computed a coefficient of determination by applying an ANOVA. For Model 1 in Table 11 the sum of squares of the regression was 27.82 with 1 *df*, and for the residual it was 117.55 with 146 *df*. With $f = 34.55$ the significance of Factor E as a predictor of level of implementation was $p < .001$.

Table 11 ANOVA of Factor E[a] and Factor G[b]

Model 1	Sum of Squares	df	Mean Square	F	Sig.
Regression	27.82	1	27.82	34.55	.001[a]
Residual	117.55	146	.805		
Total	145.37	147			

[a] Predictors (Constant), Commitment to Program Values
[b] Dependent Variable: Level of Implementation

According to the regression analysis only Factor E, commitment to the value of the program's goals, was used to predict a positive level of implementation of reform-based instructional practices in the classroom, p= .001. Factors A, B, C, and D were not significant contributors. Table 12 shows the results of the analysis of these factors.

Table 12 Excluded Variables[a] in Regression

Model 1	Beta In	t	Sig.	Partial Correlation	Tolerance
Initial Training	.115[a]	1.397	.165	.115	.815
Project Follow-up	.131[a]	1.662	.099	.137	.879
Project Support	.095[a]	1.206	.230	.100	.886
School/District Support	.122[a]	1.569	.119	.129	.909

[a] Dependent Variable: Level of Implementation

Revised Model

The results of the multiple regression analysis only partially confirmed the second hypothesis. Only one of the five staff development program factors in the study proved effective for predicting higher post-training levels of implementation of program

objectives. Figure 2 shows the revised model of the predictor for positive levels of implementation.

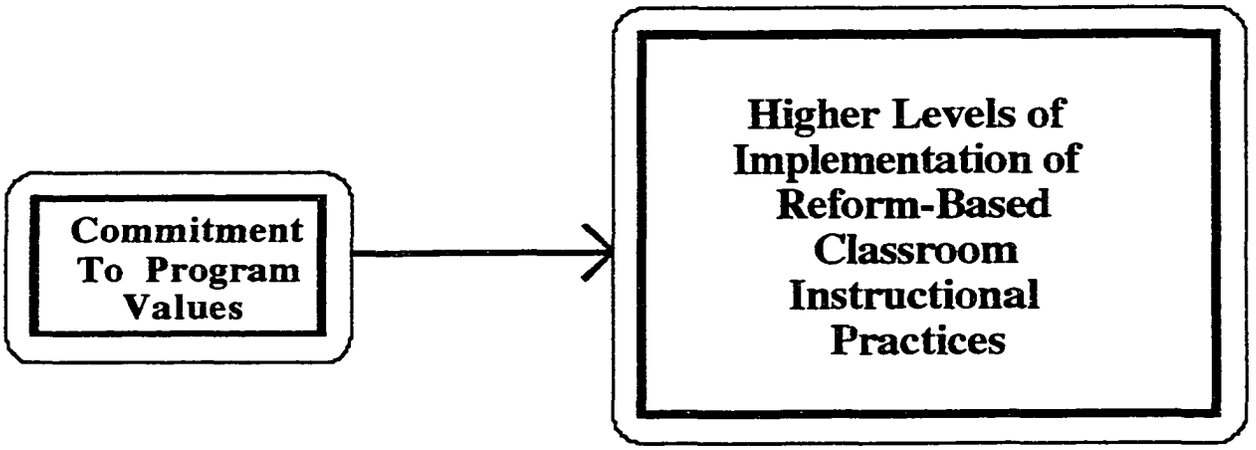

Figure 2 . Revised Model

Correlations in the *SRBSTT*

A Pearson product-moment correlation performed on the variables established statistically significant relationships among all subcategories. Table 13 shows that the subcategory Factors A, B, C, D, E, and G had a Pearson correlation coefficient at the $p < .01$ significance level. Thus the *SRBSTT* was shown to have correlations that were significant enough to be useful in making predictions about the effects of the independent variables (Factors A, B, C, D, & E) on the dependent variable (Factor G).

Table 13 Correlations of Dependent and Independent Variables

		Initial Training	Project Follow-up	Project Support	School /District Support	Commit-ment to Values	Level of Imple.
Initial Training	Pearson-Corr.	1.00	.636**	.548**	.343**	.430**	.281**
	Sig. (2-Tailed)	.	.000	.000	.000	.000	.001
	N	148	148	148	148	148	148
Project Follow-up	Pearson-Corr.	.636**	1.00	.684**	.276**	.348**	.268**
	Sig. (2-Tailed)	.000	.	.000	.001	.000	.001
	N	148	148	148	148	148	148
Project Support	Pearson-Corr.	.548**	.684**	1.00	.497**	.338**	.232**
	Sig. (2-Tailed)	.000	.000	.	.000	.000	.005
	N	148	148	148	148	148	148
School/ District Support	Pearson-Corr.	.343**	.278**	.497**	1.00	.301**	.242**
	Sig. (2-Tailed)	.000	.001	.000	.	.000	.003
	N	148	148	148	148	148	148
Commit. To Program Values	Pearson-Corr.	.430**	.348**	.338**	.301**	1.00	.437**
	Sig. (2-Tailed)	.000	.000	.000	.000	.	.000
	N	148	148	148	148	148	148
Level of Implementation	Pearson-Corr.	.281**	.268**	.232**	.242**	.437**	1.00
	Sig. (2-Tailed)	.001	.001	.005	.003	.000	.
	N	148	148	148	148	148	148

** Correlation is significant at the 0.01 level (2-tailed)

Examination of the *SRBSTT's* Five Program Factors

Initial Inservice Training Component

Factor A, initial program training, included items pertaining to teacher participant perceptions of their two-week or three-week initial inservice training experience. It was hypothesized that Project LIFE teachers would have positive perceptions about their initial inservice experience, and that these perceptions would be highly correlated to their levels of implementation of reform-based practices (Factor G). Responses to Factor A did reflect favorable perceptions about the program inservice component, but the correlation between Factor A and Factor G was $p= .165$. It did not meet the $p< .05$ level of significance criterion. Discussion of this factor and possible implications of the findings can be found in Chapter 5.

Program Follow-up

Project LIFE had a definitive follow-up program for the year following each teacher's induction into the program. Four to six additional workshops were offered during the follow-up year, and a Science Expo for participants to present and share an original research project was a required part of the program There were no provisions made for participants to observe each other's classroom practices, although some participants were able to arrange this on their own. The survey item pertaining to classroom visits (B14, *Enough opportunities visit other participants' classrooms*) was eliminated from the single factor variable for Factor B because it did not correlate with the other items in Factor B on the initial factor analysis. However, even without the issue of shared classroom visits, Factor B, project follow-up, showed no significant relationship to level of implementation ($p= .099$). Despite the lack of significant impact on levels of implementation found in this study, follow-up does seem to matter to teachers. In the short answer response part of the survey instrument respondents called

on Project LIFE to continue its outreach to them through more workshops, further training, ongoing newsletters, and on-line communications in future years (n= 30). Quotes from teachers included the following two responses:

- I'm hooked on reform now that I have received Project LIFE [training]. But I do not want to be *cut off* from its influence. I'm reminded of the old adage, "out of sight, out of mind." I believe that the critical next step would be the continuation of collaborative communication between LIFERs. A yearly booklet of new activities with assessments that have been submitted by members of the *Science for LIFE Club* would be an exciting thought.

- I believe that it will be vital to the success of reform that we make collaborative connections among islands of learners/teachers that will last forever. Plan ways that teachers at a certain level of training in their roads to reform can continue to progress. If neglected, the seed will not grow.

Program Support

Additional support from Project LIFE continued for one school year after the participant's initial training. The site coordinator visited the classroom of each teacher at least two times, four to six extensive newsletters were sent to all participants, supplies and materials were delivered to each participant, opportunities for training were offered to their administrators, and assistance was given in ensuring that all participants attended their state science conventions. In response to the short answer items several participants wrote about the need for more training of administrators (n= 39). One teacher echoed the views of many:

> If the administration could somehow see the importance of reform-based science teaching, then that support would be beneficial. The teacher is always defending this method of teaching to parents, students, faculty members, and the public; it is very disheartening to have an administration that doesn't understand, and therefore, doesn't see the need for this kind of teaching.

Even though in reality few of their administrators chose to participate in the training offered them by the Project LIFE Program, respondents on the average gave item C19 (*satisfactory training for administrators in my school/district*) a score consistent with the other item variables, and it was included in the single factor variable

for Factor C. The results of the multiple regression analysis showed no significant relationship between Factor C and level of implementation (p= .230)

School/District Support

Current research on professional development points to school/district support as one of the most important areas of emphasis to ensure successful transfer of training into actual classroom practice (Guskey & Huberman, 1995; Loucks-Horsley et al., 1998; Reys et al., 1997; Sparks & Hirsh, 1997; Showers & Joyce, 1996). School/district support for purposes of this study referred to having colleagues who were similarly trained and to being provided with time and opportunity to meet with them, having administrators who were knowledgeable and supportive of reform-based instructional strategies, having adequate planning time and financial resources to implement new strategies, having technological support when needed, and having adequate classroom facilities and supplies to implement reform-based science strategies. The only item which did not load into the single factor variable for Factor D was item 28 (*Competing demands at school have greatly interfered with my ability to implement reform-based science strategies*). Factor D, at p= .119, did not meet the p< .05 criteria for inclusion as a predictor to transfer into classroom practice.

Teachers, however, had much to say about school/district support. In response to the short answer item Question 2 (*What improvements could be made to assist you in implementing reform-based science teaching in your classroom?*) on the survey instrument they cited more time needed for planning and preparation (n= 42), need for more appropriate and better facilities (n= 36), need for training more teachers at the same school and district to help with both vertical and horizontal alignment (n= 30), and need for more collegiality and communication among teachers (n= 29).

- I really want to do everything I learned in Project LIFE, but there is so little time at my school for planning and preparation. I have 5 different preps

[preparations for 5 different classes each day] this year. I just can't seem to get it all done. Oh, my kingdom for some planning time . . .

- Can you imagine a doctor trying to take care of his patients without the proper facilities or equipment? The public would never let that happen, but look what happens to teachers! It's hard to do an active hands-on science program when you have a tiny room, one electrical outlet, slanted desks, no running water, no shelves, no locking storage cabinets, and only the supplies you received from the Project LIFE program. I'm trying to do my best, but I need a new room, more equipment, and some help here!

- I'm the only teacher in my district who was trained in this reform-based methodology. I feel like I'm fighting the battle all alone. It would be better if you could train teams of teachers from the same school or at least schools close to each other so that everyone has a *buddy* to help support them.

Commitment to Program Values

As shown previously in the model summary in Table 10, the only independent variable which could be used to predict levels of implementation was Factor E, commitment to the program values. Respondents were asked to indicate their agreement or disagreement with statements about the value of reform-based teaching. Items included statements that a reform-based science curriculum is needed to help students achieve national standards, can help students become lifelong learners, can help all students, and better meets the needs of students that more traditional approaches. Additional statements were about the feasibility of implementing reform-based science in any classroom even with a lack of equipment, extensive materials, and technological resources. The final item epitomized the teacher's belief system (Item 36, *A reform-based science curriculum is that way I would like to have been taught science.*). All items in this component loaded into the single factor extraction for Factor E.

This study shows that teacher participants' commitment to program goals can account for 19 percent of reported subsequent positive levels of implementation of program goals. The significance level for this is $p < .001$. The research for this study confirmed only one part of its second hypothesis, that teacher perceptions of and

commitment to the value of the program's goals can be used to predict a positive level of implementation of reform-based instructional practices in their classrooms.

It can be argued that teachers who voluntarily enrolled in a reform-based inservice program such as Project LIFE were a self-selected group who manifested a predisposition toward the program objectives. However, the non-Project LIFE teachers returning surveys indicated that 24 percent of them had participated in other voluntary science inservice programs that lasted two weeks or more.

The *SRBSTT* Item 5 (*Do you have any thoughts or ideas that have not been addressed in this survey*?) provided former Project LIFE teachers with an opportunity to speak to any areas of importance to them that may have been overlooked in the survey. Subjects who answered this part of the survey unanimously offered their gratitude about having been involved with the program. Representative of thoughts conveyed in this part of the survey were comments such as these:

- Of all the classes I have been in, the instructors of Project LIFE have had the greatest and most influence on me to improve my teaching.
- It was the best educational experience I have ever had. I grew professionally as well as personally.
- I have been to several workshops, but this one was by far the most practical with the greatest potential for actually changing the way a person teaches.

The open-ended short answer part of the *SRBSTT* Item 4 (*What are your suggestions for improving science reform-based inservice training?*) gave former Project LIFE participants an opportunity to speak to the issue of enhancing the quality of not only the Project LIFE Program, but also any other science inservice training programs. The general responses indicated that subjects believed that there should be more programs like Project LIFE (n= 78).

Summary

In summary this research examined two hypotheses. Methods for hypothesis one included an experimental and a control group in a t-test of independent samples comparing levels of implementation of reform-based classroom practices between the two groups. The Project LIFE teachers showed statistically significant higher levels of implementation than did the non-Project LIFE teachers, thus confirming the first hypothesis.

A second research focus examined teachers' perceptions of staff development program components and their influence on subsequent classroom practices. In testing hypothesis two, a multiple regression analysis was implemented using the levels of implementation as the dependent variable and five staff development program components as the independent variables. An analysis of the data revealed that four of the five program components showed no significant impact on higher reported subsequent levels of implementation of program objectives. However, data from the qualitative elements of the study revealed that teachers feel strongly about the importance of the other four program components, despite findings of the lack of correlation to levels of implementation of program objectives. The second hypothesis was partially confirmed in that one program component, the participant's commitment to the program's values, was shown to be a statistically significant indicator of post-training levels of implementation.

To conclude, this study was based on survey data and is subject to all the limitations of self-report instruments. It appears from the quantitative and qualitative data collected that participation in Project LIFE does positively affect the level of implementation of reform-based science instructional practices in the classroom, and that the best predictor of whether or not teachers will transfer their training into practice is their level of commitment to program values.

CHAPTER V

DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

This study has shown that Project LIFE teacher participants report higher levels of implementation of reform-based classroom practices than do those teachers who have not participated in Project LIFE. The first hypothesis in this study was confirmed by the data. The higher levels of implementation for Project LIFE teachers was even more important when considering that Project LIFE respondents varied in their program years of participation. Therefore, it can be assumed that Project LIFE teachers who had the program as long as seven years ago were maintaining the program objectives in their classrooms.

Results for the second hypothesis were not as hypothesized. The second hypothesis guiding this study was that teacher perceptions of five staff development program factors of initial training, project follow-up, project support, school/district support, and commitment to the value of the program's goals can be used to predict a positive level of implementation of reform-based instructional practices in their classrooms. This hypothesis was only partially confirmed. In this study, only Factor E, commitment to the value of the program's goals, could be used to predict a positive level of implementation of reform-based instructional practices in the classroom. Many agree that effective staff development is intrinsic to initiating the desired reform-based teaching and that the teacher is the main mediator between any curricular reform and school practice (Anderson, 1998; Aríza & Gómez, 1992; Haney, et al., 1996;

Darling-Hammond, 1996; O'Brien, 1992; Lauriala, 1992; Stein & Wang, 1988; Sykes, 1996). There is a consensus among researchers about the need to explore how professional development programs impact educational goals through subsequent implementation of the program's objectives.

Stein and Wang (1988) maintain that, "Particularly lacking is information on the motivational factors undergirding change efforts, including how and why innovative programs are adopted and maintained by teachers" (p. 171). In order to examine this problem the researcher chose to study an established science reform-based staff development program, Project LIFE. It was the researcher's hypothesis that Project LIFE has had a positive impact on its teacher participants' levels of implementation of reform-based science instructional practices as compared to a similar group of non-Project LIFE teachers. It was also hypothesized that by surveying former participants of Project LIFE about their perceptions regarding certain program factors, an analysis could be made about which program factors most affected post-training implementation of program objectives.

A thorough review of current literature produced no specific instrument for measuring these inquiries, but did isolate five component parts of staff development that are presently thought to impact levels of subsequent classroom implementation. The literature review had suggested the inclusion of initial training, project follow-up, project support, school/district support, and commitment by the participant to the program's core values in the survey instrument. Recent research has shown high correlations among these variables and successful implementation of program objectives (Guskey & Huberman, 1995; Loucks-Horsley et al., 1998; Reys et al., 1997; Sparks & Hirsh, 1997; Showers & Joyce, 1996; Veenman et al., 1994). Questions about these areas were incorporated into the *Survey of Reform-Based Science Teacher Training*

(SRBSTT) instrument developed by the researcher and later validated by five experts in the field.

Comparison of Levels of Implementation

Results from this study confirmed the study's hypothesis that participation in Project LIFE positively affected the level of implementation of reform-based science instructional practices in the classrooms of its participants as compared to a similar group of non-Project LIFE science teachers. It further supported findings from earlier studies (McGee-Brown, 1998; Radford, 1998) that Project LIFE is a successful inservice science program which had a positive effect on classroom practices. Although the first part of the *SRBSTT* did not address the issue of pre- and post-Project LIFE attitudes and implementation, the open-ended questions gave respondents a chance to compare these two areas. Respondents reported that Project LIFE had positively affected both. Additionally, earlier research (McGee-Brown, 1998; Radford, 1998) showed significant positive changes in pre- and post- levels of attitudes about science teaching, knowledge of process skills, content knowledge, and implementation of classroom reform-based instructional strategies among participants in the year immediately following their program induction. Both qualitative and quantitative data suggest that this staff development program is producing results congruent with national efforts at reform-based teaching practices. It is important to note that this study involved teacher participants removed as much as seven years from their initial Project LIFE training, and the results were still positive. In response to the many calls for more longitudinal studies of actual implementation of staff development program objectives, this study certainly suggests that implementation of the reform-based science instructional strategies advocated by this staff development program have been maintained over time. It would seem beneficial, therefore, to study this program's

participants in searching for key factors of ensuring success when planning other inservice programs.

Impact of Program Factors on Program Implementation

Results from this study failed to support the hypothesis that teacher perceptions of staff development program factors of initial training, project follow-up, project support, school/district support, and commitment to the value of the program's goals can be used to predict a positive level of implementation of reform-based instructional practices in their classrooms. This study showed that the only staff development program factor which could be used to predict positive levels of implementation of the Project LIFE objectives is the participant's commitment to the values of the reform-based program. In contrast to previous research which indicates that the quality of the initial training experience (Aríza & Gómez, 1992; Gibbons et al., 1997; Loucks-Horsley et al., 1998), the amount of program follow-up (Gibbons et al., 1997; Guskey, 1995; Haney et al., 1996; Huniker, 1996; Loucks-Horsley et al., 1998; Pink, 1989), the extent of program support (Borko & Putnam, 1998; Gibbons et al., 1997; Haney et al., 1996; Huinker, 1996, Loucks-Horsley et al., 1998; Pink, 1989; Sparks, 1994; Stein & Wang, 1988), and the local and district support (Haney et al., 1996; Ishler et al., 1998; Little, 1993; Loucks-Horsley et al., 1998; McBride et al., 1994; Showers & Joyce, 1996; Sparks & Hirsh, 1997) directly influence the success or failure of actual classroom practice, this study found none of these factors to be significant in predicting positive implementation of professional development. Only one factor was significantly correlated -- that of commitment. Comments from teachers in this research study suggest that many of them perceive all five staff development factors as being important, but results from the quantitative aspect of this study indicate that only commitment to the program's values mediates the levels of implementation.

Importance of Commitment to Program Values

Windschitl (1999) believes that reform-based instruction along with the discrete practices that have been associated with it (cooperative learning, alternative assessment, hands-on learning, and other strategies) is more than a set of teaching techniques. He says, "It is a coherent pattern of expectations that underlie new relationships between students, teachers, and the world of ideas" (p. 752). He maintains that everything in a teacher's classroom from how the desks are arranged to how learning tasks are approached make statements about what the teacher values. If, in fact, reform-based instructional practices reflect an inherent value system, then it only makes sense that teachers must internalize a deep commitment to its fundamental premises before they will be able to commit to long term practices.

In writing about the CBAM model O'Brien (1992) states, "Change is a highly personal experience where teacher perceptions and feelings are at least as important as the innovation's trappings and technology" (p. 423). Haney et al. believe that ignoring the influential nature of teacher beliefs on changing teacher practices has caused previous reform efforts to fail (1996). Clark & Astuto address the concept of motivation as one which can be viewed in two ways:

> Motivation is a complicated and multidimensional concept that becomes still more confusing when applied to the work place. Experience, popular theoretical frameworks, and research about organizations all combine to create our beliefs about motivation. And, of course, different perspectives yield different insights. One of the deepest differences in their basic assumptions with regard to motivation is evident in the fact that many people believe that individuals are motivated to achieve institutional objectives by institutional incentives, while others believe that individuals are self-motivated to achieve institutional objectives unless blocked by the organizational environment. (1994, p. 515)

It is the opinion of this researcher that the latter is more true -- that most teachers are self-motivated and will pursue practices congruent with their value systems unless blocked by the institutional environment. Thus it would follow that the foremost goal of

successful staff development programs should be to focus on helping teachers internalize and commit to attainment of the program's objectives. Subsequent to that, program developers should ensure that the other program factors such as follow-up and support (at all levels) are in place.

Attitude as Related to Commitment to Values

Lasley et al. (1998) referred to the popularized *change process* (initiation, implementation, and continuation) when they stated:

> The most critical stage is initiation, which occurs when staff members either embrace or reject the innovation and develop a shared meaning as to the change. It is at this stage that attitudinal dissonance is at its most critical point. (p. 122)

Others agree that without an initial *buy in*, teachers will never be open to other essential components of the program. "Teachers have a system of beliefs and personal constructs about teaching which operate as a cognitive filter, sometimes even as a cognitive obstacle with respect to new learning" (Aríza and Gómez, 1992, p. 538). These researchers believe that behavior is the result of the influence of diverse variables such as attitudes and emotions which occur within a process that which, to a large extent, is out of any conscious control. Perhaps it is best summed up by saying that attitude dispositions influence teachers' willingness to change.

One may question at this point if the participants' commitment to the values of Project LIFE were in place before the staff development program and were unchanged by it, were somewhat present before the staff development program and were reinforced by it, or were scarcely or not at all present before the staff development program and changed because of it. The question can be partially answered by looking at past research (McGee-Brown, 1998; Radford, 1998) which found that attitudes and practices were positively changed by the program. A review of the Project LIFE model might be helpful at this point.

The Project LIFE Model

The developers of Project LIFE provided a dynamic approach to staff development. Participants were immersed in the practices Project LIFE staff wanted them to replicate in their own classrooms. Project LIFE staff engaged teacher participants in reform-based practices that included cooperative learning, alternative assessment, the learning cycle, and others throughout the participants' initial inservice experiences as well as in follow-up workshops. Inquiry learning, active engagement, and research projects ensured that teachers became the learners. Participants were encouraged to experiment, to discuss, to reflect, and to write daily about their feelings.

Project staff members were as attentive to teacher needs in the affective domain as in the cognitive and psychomotor domains. Concerted efforts were made to ensure that teachers were engaged, were comfortable, and were satisfied. It was important to the Project LIFE instructors that teachers enjoyed themselves and had fun as well as learned important ideas, skills, and practices.

The Project LIFE program had as its logo, the butterfly, because the program was purposefully designed to help teachers undergo a metamorphosis into not only being changed but becoming change agents. The question of how much influence Project LIFE had on the participants' commitment to the values the program extolled is an area that needs further research.

Conclusions

Reform-based staff development programs that immerse teachers in the desired practice can impact post-training levels of program implementation. Science teachers who participated in the Project LIFE staff development program in seven different program years (1992-1998) reported significantly higher levels of reform-based classroom practices that did their non-Project LIFE counterparts.

Teachers perceptions of other factors such as initial training experience, program follow-up, program support, and school/district support, mattered less to their post-training classroom practices than did their beliefs about the value of the staff development program's objectives. This finding suggests that staff development programs should pay particular attention to the attitudes teachers have toward the anticipated implementation of reform-based practices before alterations of other factors are expected to lead to lasting change in classroom practice. Providing for other factors without attending to teacher belief factors may negate the desired outcomes.

Recommendations

Additional Research on the Project LIFE Group

The Project LIFE model is worthy of further study because of the demonstrated higher levels of post-training implementation found among its participants as compared to non-Project LIFE counterparts (See Table 6). Areas which would be of interest for further study include:

1. What difference, if any, were there among implementation levels of different demographic subgroups (i.e. males and females, participants from different program years, participants who taught in different geographical settings, participants who commuted and participants who resided at the training site, backgrounds in science education, and grade levels taught)?
2. How important were incentives and motivators to participants? Were perceptions of these related to implementation of program practices?

Other Research Areas

Perhaps a message from this study is that one way of designing and delivering an effective staff development program is by creating a total experience -- both professional and personal -- for teachers. Like Project LIFE and other effective staff development programs, future planners could foster safe and caring environments that model all of the practices they hope to have emulated by teacher participants. This seems to be one way to facilitate a desired change in teacher attitudes. More research is needed to explore this idea.

There is a need for more studies on motivational factors related to teacher behavioral change, alternative ways to foster teachers' motivation, and ways to help maintain those changes once they occur. Business and industry spend millions of dollars each year on this area because they know their investment is worth the cost in terms of long range payoff through improved employee performance. It is the task of professional development planners for education to help motivate teachers towards a willingness to grow and change so that national goals can be met, and the ultimate consumer, the student, will benefit.

In line with this thinking, another area that needs exploration is that of preservice teacher training. If positive teacher attitudes help foster improved classroom practices, then certainly much needed studies about which factors most influence preservice teacher attitudes are mandated. Early socialization of future teachers into the values of reform-based instructional strategies could serve to further increase commitment to the values of effective teaching practices. Pre-service education programs could benefit from research which addresses the constructs of commitment, values, and beliefs about teaching. Motivation-related factors found to enhance transfer of training for practicing teachers could be utilized to facilitate acquisition and transfer of reform-based instructional practices by pre-service teachers.

Research is needed on the social-psychological determinants of commitment. The constructs of the commitment variable need to be identified so that the salient components of this concept can be fostered and applied to the implementation of newly learned practices. Extant literature on teacher characteristics associated with commitment to program values is sparse. A more descriptive data base about the relationship between teacher traits and commitment is essential for success in implementing innovative teaching and learning practices.

Given that only 19 percent of the variability in levels of implementation was accounted for in this study, it would appear that there is still much need for research on staff development program factors which impact subsequent implementation levels of program objectives. Previous research has clearly demonstrated that teachers do need staff development program follow-up and support. Even though the issue of school/district support was not significant in this study, other researchers have found that factors such as financial aid, release time, recognition, and collegiality are important determiners in the successful classroom implementation of program components. Teachers need time and direction for reflective thinking. They need to talk to one another as colleagues and support one another as fellow sojourners. Windschitl (1999) believes that in order for teachers to implement reform-based strategies, they must develop a new, well-articulated rationale for instructional decisions. This rationale development needs local support in every sense of the word. In terms of supporting the change process schools must not ignore important factors such as more collegiality, additional materials and supplies, more planning time, more appropriate facilities, and more administrative support for those who are trying new ideas.

Summary

In order to reach national goals of reform, teachers and teacher training are the key. This study supports the notion that teacher beliefs are significant contributors to behavioral practices associated with national goals. The findings of this research support the belief that teacher commitment is the single most influencing factor in successful ongoing implementation of reform-based instructional practices. Staff development designers must explore ways to use this persuasive information to plan programs which will foster within teachers a disposition to want to change. As Lasley et al. (1998) put it, "they must learn what methods prove effective in moving teachers 'off the dime.'" If, as this researcher believes, teachers are truly self-motivated learners whose greatest intrinsic reward is reaching a child, seeing growth, and fostering learning, then it is imperative to show them that reform-based learning is the best way to help students, and to set in place a support system to nurture educators as they make needed changes. Perhaps it means that ownership of reform goes hand in hand with success, and the best way for teachers to be successful is to be actively engaged, immersed, and supported in ongoing *reformed* staff development.

APPENDIXES

APPENDIX A

Survey of Reform-Based Science Teacher Training
Demographic Information

Please fill out and leave this sheet attached when you return your survey. Thanks!

Demographic Information:

1. Please check each year that you participated in a Project LIFE Summer Program:

___ 1992 ___1993 ___1994 ___ 1995 ___1996 ___1997 ___ 1998

2. Age _____

3. Gender ___ M ___ F

4. Ethnicity ___Blk ___Wht ___Hisp ___Other

5. Years teaching experience _____

6. Years teaching science _____

7. Current position ___ Classroom Teacher For Grade(s)- _____

___ Administrator Describe Position- _____

_____

___ Other Describe Position- _____

_____

8. Description of school ___ rural ___ suburban ___ urban

9. Undergraduate major in college _____

10. Undergraduate minor in college _____

11. I participated in the Project LIFE summer program primarily as a: ***Circle one***

COMMUTER or RESIDENT (stayed in hotel or dorm)

APPENDIX B

Survey of Reform-Based Science Teacher Training
Long Form for Experimental Group

Reaction Survey:

Listed below are factors that contribute to the success or failure of an initiation, implementation, and institutionalization of a concept or technique.

Please circle the number that best describes your opinion of each question.

6 = Strongly Agree
5 = Agree
4 = Tendency to Agree
3 = Tendency to Disagree
2 = Disagree
1 = Strongly Disagree

A. My Basic Program Level Training (Summer Course) Provided:	Strongly Agree	Agree	Tendency to Agree	Tendency to Disagree	Disagree	Strongly Disagree
1 Sufficient time for acquiring the knowledge to implement the techniques taught in Project LIFE.	6	5	4	3	2	1
2 Sufficient time for acquiring the skills to implement the techniques taught in Project LIFE.	6	5	4	3	2	1
3 Emphasis on basic science concepts.	6	5	4	3	2	1
4 Emphasis on reform instructional practices.	6	5	4	3	2	1
5 Integration of process skills in the activities.	6	5	4	3	2	1
6 The appropriate amount of time for reflection and writing about the experiences in Project LIFE.	6	5	4	3	2	1
7 Assessment that modeled authentic/real life experiences.	6	5	4	3	2	1
8 Modeling of classroom implementation strategies.	6	5	4	3	2	1
9 Attention to diverse learning styles and intelligences.	6	5	4	3	2	1
10 Modeling of inquiry learning and questioning techniques.	6	5	4	3	2	1

B. Follow-up Training from the Program Included:	Strongly Agree	Agree	Tendency to Agree	Tendency to Disagree	Disagree	Strongly Disagree
11 Additional ongoing instruction and practice.	6	5	4	3	2	1
12 Opportunities to meet and share with fellow participants.	6	5	4	3	2	1
13 Assistance in attending professional conferences.	6	5	4	3	2	1
14 Opportunities to visit other participants' classrooms.	6	5	4	3	2	1
15 Occasions to present and share research with one another.	6	5	4	3	2	1

C. Follow-up Support from the Program:	Strongly Agree	Agree	Tendency to Agree	Tendency to Disagree	Disagree	Strongly Disagree
16 Included sufficient site visits by the training staff.	6	5	4	3	2	1
17 Provided adequate newsletter coverage.	6	5	4	3	2	1
18 Included enough basic materials and supplies for implementation of the program.	6	5	4	3	2	1
19 Provided satisfactory training for administrators in my school/district.	6	5	4	3	2	1

Survey of Reform-Based Science Teacher Training
Long Form for Experimental Group

D. On-site Implementation:	Strongly Agree	Agree	Tendency to Agree	Tendency to Disagree	Disagree	Strongly Disagree
20 Discussions with colleagues in the school/district about successes in reform-based science teaching have been helpful.	6	5	4	3	2	1
21 Discussions with colleagues in the school/district about concerns with reform-based science teaching have helped me improve my skills and instructional techniques.	6	5	4	3	2	1
22 One or more colleagues trained in reform-based science teaching where I work has provided me with encouragement for implementing the new techniques.	6	5	4	3	2	1
23 Having an administrator who has been trained in reform-based science strategies has enhanced my ability to implement new science program techniques.	6	5	4	3	2	1
24 Having parents who understand the new reform-based science goals and methods has helped me implement new science program ideas.	6	5	4	3	2	1
25 Having scheduled planning time for reform-based science strategies has helped me implement new science program goals.	6	5	4	3	2	1
26 Ongoing financial support is given by school/district for implementation of reform-based science strategies.	6	5	4	3	2	1
27 Ongoing technical support is given by school/district for implementation of reform-based science strategies.	6	5	4	3	2	1
28 Too many competing demands interfere with implementation of reform-based science strategies.	6	5	4	3	2	1
29 Implementing science reform-based curriculum is part of my school district's overall vision/goals.	6	5	4	3	2	1

E. A Reform-based Science Curriculum:	Strongly Agree	Agree	Tendency to Agree	Tendency to Disagree	Disagree	Strongly Disagree
30 Is needed to help students achieve national standards in science education.	6	5	4	3	2	1
31 Includes instructional techniques that can help all students learn.	6	5	4	3	2	1
32 Helps students to become life-long learners.	6	5	4	3	2	1
33 Better meets the needs of students than traditional approaches such as rote memorization and reliance on lecture.	6	5	4	3	2	1
34 Can be implemented in any science classroom.	6	5	4	3	2	1
35 Requires complicated equipment, extensive materials, and technological resources that most schools cannot afford.	6	5	4	3	2	1
36 Is the way I was taught science or the way I wish I had been taught science.	6	5	4	3	2	1

Survey of Reform-Based Science Teacher Training
Long Form for Experimental Group

F. Other Program Factors:	Strongly Agree	Agree	Tendency to Agree	Tendency to Disagree	Disagree	Strongly Disagree
37. Receiving graduate credit for participation in the program was important to me.	6	5	4	3	2	1
38 Being able to order the materials and supplies I wanted was important to me.	6	5	4	3	2	1
39 Two weeks is the right amount of time for the summer training.	6	5	4	3	2	1
40 Receiving stipends for participating in the program was important to me.	6	5	4	3	2	1

In the following table please circle the number that most reflects the amount of your *overall normal class time* that you spend on the following instructional strategies:

6 = From 81% to 100% 4 = From 41% to 60% 2 = From 1% to 20%
5 = From 61% to 80% 3 = From 21% to 40% 1 = Not at all

(Remember that there are no right or wrong answers. The best possible answer is your most *factual, accurate* estimation).

G. The amount of time I am able to spend on these science instructional strategies is approximately:	From 81% to 100%	From 61% to 80%	From 41% to 60%	From 21% to 40%	From 1% to 20%	No Time At All
41. Cooperative learning activities	6	5	4	3	2	1
42. Learning cycle/discovery approach to instruction	6	5	4	3	2	1
43. Reading from the textbook	6	5	4	3	2	1
44. Hands-on/minds-on activities	6	5	4	3	2	1
45. Science process skills	6	5	4	3	2	1
46. Factual recall	6	5	4	3	2	1
47. Alternative assessments	6	5	4	3	2	1
48. Multi-disciplinary instruction	6	5	4	3	2	1
49. Writing about science	6	5	4	3	2	1
50. Drill and practice	6	5	4	3	2	1
51. Long-term science investigations	6	5	4	3	2	1
52. Complex questioning techniques	6	5	4	3	2	1
53. Attention to national standards and benchmarks	6	5	4	3	2	1
54. Learning logs and/or journals	6	5	4	3	2	1
55. Direct teaching/lecture	6	5	4	3	2	1

Survey of Reform-Based Science Teacher Training
Long Form for Experimental Group

H. Please use short answers to respond to the following: (Use the back if needed)

1. Compare your science teaching prior to your Project LIFE inservice training to your science teaching after having been through the program.

2. What improvements could be made to assist you in implementing reform-based science teaching in your classroom?

3. How important were the following items to you: receiving t-shirts, door prizes, certificates and other "perks?"

4. What are your suggestions for improving science reform-based inservice training?

5. Do you have any thoughts or ideas that have not been addressed in this survey? If so, please feel free to write about them here.

APPENDIX C

Survey of Reform-Based Science Teacher Training
Short Form for Control Group

In the following table please circle the number that most reflects the amount of your overall normal class time that you spend on the following instructional strategies:

6 = From 81% to 100% **4 = From 41% to 60%** **2 = From 1% to 20%**
5 = From 61% to 80% **3 = From 21% to 40%** **1 = Not at all**

Remember that there are no right or wrong answers. The best possible answer is your most *factual, accurate* estimation. Answers will not necessarily total 100%.

The amount of time I am able to spend on these science instructional strategies is approximately:	From 81% to 100%	From 61% to 80%	From 41% to 60%	From 21% to 40%	From 1% to 20%	No Time At All
1. Cooperative learning activities	6	5	4	3	2	1
2. Learning cycle/discovery approach to instruction	6	5	4	3	2	1
3. Reading from the textbook	6	5	4	3	2	1
4. Hands-on/minds-on activities	6	5	4	3	2	1
5. Science process skills	6	5	4	3	2	1
6. Factual recall	6	5	4	3	2	1
7. Alternative assessments	6	5	4	3	2	1
8. Multi-disciplinary instruction	6	5	4	3	2	1
9. Writing about science	6	5	4	3	2	1
10. Drill and practice	6	5	4	3	2	1
11. Long-term science investigations	6	5	4	3	2	1
12. Complex questioning techniques	6	5	4	3	2	1
13. Attention to national standards and benchmarks	6	5	4	3	2	1
14. Learning logs and/or journals	6	5	4	3	2	1
15. Direct teaching/lecture	6	5	4	3	2	1

Demographic Information

1. Please check each year that you participated in a reform-based science teaching program/project (that lasted 2 weeks or more in length).

___ 1992 ___1993 ___1994 ___ 1995 ___1996 ___1997 ___ 1998

2. Age _____ 3. Gender (check one) ___ M ___ F

4. Ethnicity (check one) ___Blk ___Wht ___Hisp ___Other

5. Years teaching experience _____ 6. Years teaching science _____

7. Current position (check one) ___ Classroom Teacher For Grade(s)- _____
___ Administrator Describe Position- _____
_____
___ Other Describe Position- _____
_____

8. Description of school (check one) ___ rural ___ suburban ___ urban

9. College Major _____ 10. College Minor _____

APPENDIX D

Approval Memorandum For Human Use Committee Review

LOUISIANA TECH
UNIVERSITY

RESEARCH & GRADUATE SCHOOL

MEMORANDUM

TO: Debbie Silver
Dr. Jo Ann Dauzat

FROM: Deby Hamm, Graduate School

SUBJECT: HUMAN USE COMMITTEE REVIEW

DATE: August 5, 1998

In order to facilitate your project, an **EXPEDITED REVIEW** has been done for your proposed study entitled:

"Teacher perceptions of essential components in an inservice program needed to positively impact teacher behavior in Science teaching"

Proposal # 1-NE

The proposed study procedures were found to provide reasonable and adequate safeguards against possible risks involving human subjects. The information to be collected may be personal in nature or implication. Therefore, diligent care needs to be taken to protect the privacy of the participants and to assure that the data are kept confidential. Further, the subjects must be informed that their participation is voluntary.

Since your reviewed project appears to do no damage to the participants, the Human Use Committee grants approval of the involvement of human subjects as outlined.

You are requested to maintain written records of your procedures, data collected, and subjects involved. These records will need to be available upon request during the conduct of the study and retained by the university for three years after the conclusion of the study.

If you have any questions, please give me a call at 257-2924.

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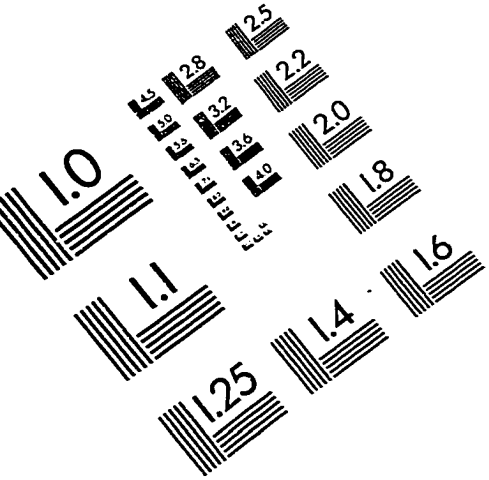
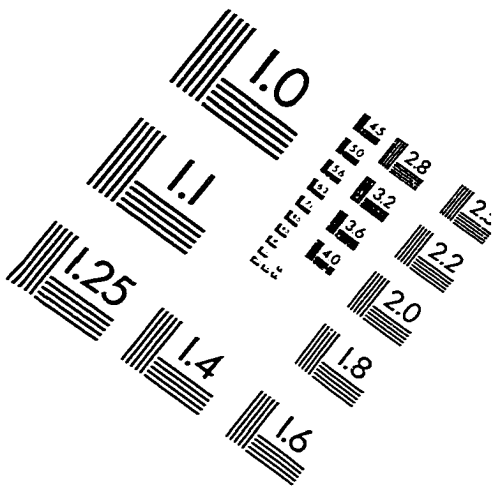
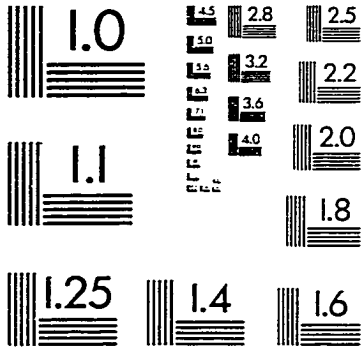
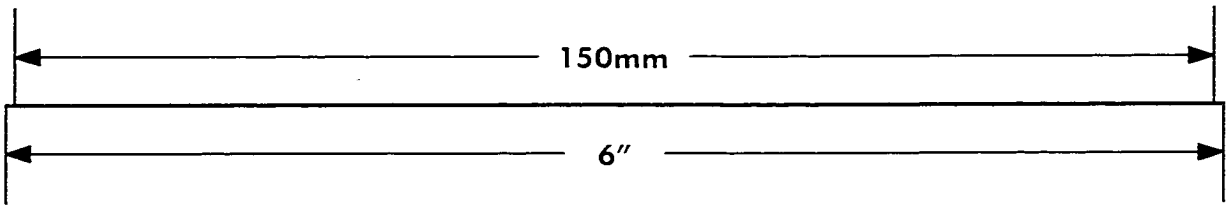
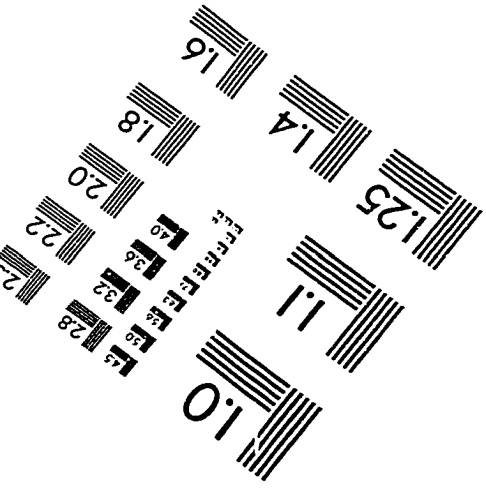
IMAGE EVALUATION TEST TARGET (QA-3)

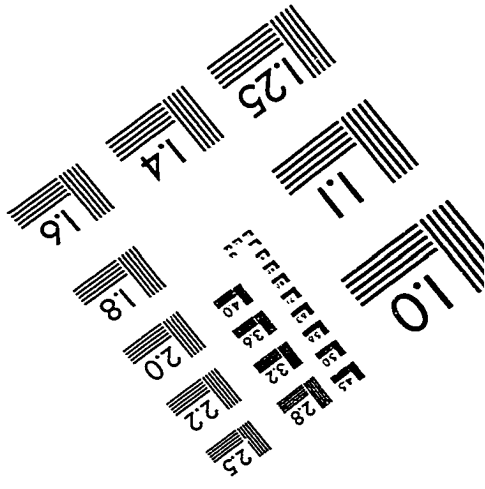












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