ENHANCING SCIENCE TEACHING IN AN ELEMENTARY SCHOOL:
A CASE STUDY OF A SCHOOL-INITIATED TEACHER PROFESSIONAL
DEVELOPMENT PROGRAM

by

CLARE M. BROOKS
B.A., Manhattanville College, 1969
B.Ed., York University, 1974
M.S.Ed., Northern Illinois University, 1980

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Department of Curriculum Studies
The University of British Columbia
Vancouver, Canada

Date 23 Sept 198
ABSTRACT

This naturalistic case study documents a year long Teacher Professional Development Program (TPDP) initiated by an elementary school staff in British Columbia. The TPDP was designed to enable the teachers to meet their objective of making science instruction more frequent, more active, and more student-centered in all classrooms in the school. This case study addresses two research questions:

1. What attributes of the Teacher Professional Development Program supported the school's "objective" for improved science instruction?
2. How did the outcomes of the Teacher Professional Development Program relate to the achievement of the school's educational objective?

The site for the research was a kindergarten - Grade 7 school. A university professor and the researcher were invited to visit the school on a bi-weekly basis during one school year (1993-94) to facilitate a series of science workshops involving the entire teaching staff and to provide classroom support to teachers. Teachers were offered university course credit for their participation.

This case study draws on qualitative data including: audio recordings of planning/debriefing sessions, workshop discussions, and interviews with participants; field notes and written observations; a survey of teachers' opinions about the TPDP; and documents relating to the school accreditation process in 1994-95.

The results of the study show that teachers, administrators, and parents were satisfied that the school's objective for science instruction was met, and that the TPDP contributed significantly to this outcome. The study identifies TPDP attributes which supported the school's objective with reference to the teachers and their context, the planning process, and the organizational context, that is, the school.

This study contributes to our understanding of teacher professional development by examining an alternative to more common approaches to elementary teacher science inservice
in British Columbia, which are typically short-term, designed by inservice providers with little input from participants, and removed physically and conceptually from the classroom. Such inservice experiences often lack administrative and collegial support for the teacher who attempts classroom implementation. While this study relates to science, the discussion is relevant to other curriculum areas such as fine arts or physical education.
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CHAPTER I

A CASE STUDY OF A TEACHER PROFESSIONAL DEVELOPMENT PROGRAM

The Origin of the Study

This intrinsic case study (Stake, 1994) documents a year long Teacher Professional Development Program (TPDP) initiated by an elementary school staff in British Columbia to improve the quality and quantity of science teaching in the school. The site for the research was Mountainview Community School (a pseudonym), a K-7 school enrolling approximately 360 children, with 22 full-time and part-time teaching staff. In September, 1992 the staff identified the improvement of science instruction as an objective for the school years 1992-95. The 3 year school growth plan submitted to the school district's superintendent of schools specified extensive and extended staff development and training, peer support, acquisition of materials and equipment, and use of University of British Columbia (UBC) personnel. The school year 1992-93 was for planning and initial orientation of staff, while the school years 1993-95 were designated as 2 years of staff development and training.

Early in 1993, the vice-principal at the school asked a university professor and me to visit the school on a bi-weekly basis during one school year (1993-94) to facilitate a series of science workshops involving the entire teaching staff. We met with the staff in March, 1993 to discuss our involvement in the coming year. At that preliminary meeting, teachers described how they thought the workshops might help them address their needs. They proposed that we offer university credit for their participation, which we did; fifteen teachers received course credit. A planning session involving the professor, principal, vice-principal and me occurred in September, 1993. Subsequent visits to the school began in October, 1993 and continued until May, 1994. The eventual form of each visit was a 2
hour class typically followed by a debriefing/planning session involving the professor, the administrators and me. For all but the first and last visits, the next day was a day of classroom support provided by the professor and me and occasionally the vice-principal. In addition, the professor and I spent two professional development days at the school.

The Educational Importance of the Study

This Teacher Professional Development Program (TPDP) differed in significant ways from more common approaches to elementary teacher inservice in science in British Columbia. In 1984, the Science Council of Canada reported that most teachers were "very dissatisfied with the quality of the inservice educational programs provided for them" (p. 20), with such programs often being ineffective or non-existent. The Council described popular approaches to teacher inservice thus: "Most of the inservice programs designed for the professional development of science teachers are group-oriented, short term, and removed both physically and conceptually from the problems of the classroom" (p. 54).

Recent studies (Bateson, Erickson, Gaskell & Wideen, 1991; Brooks, 1994a & Brooks, 1994b) show that little has changed in British Columbia since 1984. Bowman (1990), in his overview of the literature on teacher education in British Columbia, concludes that teacher professional development is not viewed as a continuum in British Columbia; rather, a teacher's pre-service teacher training is followed by a career during which professional development opportunities are plentiful, haphazard, not well-organized, and lack a philosophical coherence. Miles (1995) characterizes such approaches to teacher professional development as
Everything a learning environment shouldn't be: radically undersourced, 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 a part of a natural process, and trapped 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)

Such one-shot inservice workshops are not the only form of teacher professional development available to teachers, however. Professional development in elementary science in British Columbia is, for the most part, the responsibility of the individual teacher. Teachers read articles in professional journals such as Catalyst, the journal of the British Columbia Science Teachers' Association. Some teachers make improved science instruction a professional goal as part of the teacher evaluation process. Others work on action-research projects, alone or with a colleague, possibly as part of a university course.

Such individual approaches to teacher professional development have worth. However, present school structures and practices do not make it easy for the teacher intent on improving classroom science teaching by means of such individually initiated efforts. Teachers that I know are busy keeping up with the daily demands of teaching, such as short- and long-term planning, coaching noon-hour and after-school sports, assessing and evaluating student work, and contacting parents regarding student behavior. They are isolated in their classrooms, and have little time to communicate professionally with their colleagues. Ongoing pressures to implement new curricula and to use new assessment and evaluation procedures add to the teachers' load. University courses are costly in time and money and, for teachers in outlying areas, impractical. Such difficulties challenge the effectiveness of these individually initiated efforts at professional development. Given the rather lackluster science teaching in many elementary classrooms (Bateson, Erickson, Gaskell & Wideen, 1991), teacher professional development is needed that supports teachers' efforts to improve their science instruction. The Science Council of Canada (1984) recommends that "The major focus for the renewal of science education
should be the school itself and it is at this level that most commitment and effort is required. . . . If the renewal of science education is to be based in the school, then the school should also become the focus for planning and coordination of teachers' personal growth and continuing education" (pp. 51 & 53).

An Alternative Approach to Teacher Professional Development

The Teacher Professional Development Program (TPDP) was a strategy to enhance the classroom science instruction in one particular school. The TPDP was guided by a four-member planning team comprising the two school administrators, a University of British Columbia professor, and me. We drew on our combined experience in teacher professional development, what Sparks and Loucks-Horsley (1990) refer to as "craft knowledge" of staff development, to design an alternative to the impoverished learning environment described by Miles (1995): The TPDP was financially well-supported and sustained over a long period of time, and originated in a need identified by school staff. The program was designed to help participants change their teaching in ways they decided would be most helpful, and ownership for both the goals of the effort and the agenda resided in the school. The TPDP was the only school-based inservice for teachers and was a regularly scheduled feature of the staff's school year. Workshop time was devoted to exploring teachers' beliefs about teaching and teaching science, and to developing understandings of the nature of science learning. Workshops and classroom practice were connected, with learning and doing inextricably linked. The entire teaching staff participated in the TPDP; school administrators not only supported but led the endeavor and participated fully in the year's activities. With this design, the planning team hoped the TPDP would be an intellectually invigorating experience for both teachers and facilitators, and that teachers would become more knowledgeable about science and feel more confident about teaching science than previously, and that the staff would succeed in meeting the school's objective for improved science instruction.
The Literature on Effective Staff Development

At the conclusion of the TPDP and in the writing of this document, I examined the literature on staff development. Most helpful was a chapter written by Dennis Sparks and Susan Loucks-Horsley (1990) for the *Handbook of Research on Teacher Education* entitled "Models of Staff Development". In it, they organize what they believe to be known about effective staff development "in an effort to promote good staff development practice" (p. 234). They propose five models used by staff developers and describe what is currently known about "the organizational context required to support successful staff development efforts" (p. 234). In order to situate this case study in the staff development literature, I summarize their work.

While I refer to Sparks and Loucks-Horsley's article throughout this document, I wish to make it clear that I discovered them only after the completion of both the TPDP and data analysis; in no way was the TPDP an exploration of their ideas nor did I analyze the data with reference to their work.

**Five Models of Staff Development**

Sparks and Loucks-Horsley (1990) limit their discussion to staff development models that have an individual teacher orientation, defining staff development as "those processes that improve the job-related knowledge, skills, or attitudes of school employees" (pp. 234-235). They examine "what is known about staff development that is intended to improve student learning through enhanced teacher performance" (p. 235). They combine two uses of the word "model": "A model is seen here as learning that embodies a set of assumptions about, first, where knowledge about teaching practice comes from and, second, how teachers acquire or extend their knowledge" (p. 235); the five models they examine differ in these assumptions. Their second use of the term model is that of "a pattern or plan that can be used to guide the design of a staff development program" (p. 235).

Sparks and Loucks-Horsley discuss each staff development model in terms of its key characteristics, its underlying assumptions, and its theoretical and research underpinnings,
giving examples of researchers in the field. They describe each model's phases of activity, give illustrations of the activities, and critique evident outcomes.

**Individually Guided Staff Development**

The circumstances most suitable for one person's professional development can be quite different from those that promote another individual's growth. Consequently, individually guided staff development allows teachers to find answers to self-selected professional problems using their preferred modes of learning. (Sparks & Loucks-Horsley, 1990, p. 236)

**Key characteristics:**

- individual teachers determine their own goals
- individual teachers select activities that will result in the achievement of those goals

**Underlying assumptions:**

- Individuals are capable of self-direction and self-initiated learning.
- Individuals can best judge their own learning needs.
- Adults learn most efficiently when they initiate and plan their learning activities.
- Individuals are most motivated when they select their own learning goals on the basis of personal assessment of their needs.

**Theoretical and research underpinnings:**

- client-centered therapy (Rogers, 1969)
- adult learning theory (Kidd, 1973; Knowles, 1980)
- stage theory (Levine, 1988)
- learning styles (Dunn & Dunn, 1978; Gregorc, 1979; Hall & Loucks, 1978)

**Phases of activity:**

1. Identification of a need or interest
2. Development of a plan
3. The learning activity
4. Assessment

Illustrations:
- professional reading by individuals
- attendance at workshops or conferences
- design of special projects by individuals
- the setting of professional goals as part of the teacher evaluation process

Evident outcomes:
- Teachers are empowered to address their own problems.
- A sense of professionalism is created.
- Teachers are intellectually stimulated.

Observation/Assessment Model
Teaching can be objectively observed and analyzed and . . . improvement can result from feedback from that performance. (Sparks & Loucks-Horsley, 1990, p. 238)

Key characteristics:
- Teachers engage in an observation/feedback cycle with a supervisor or other colleague.

Underlying assumptions:
- Reflection and analysis are central means of professional growth.
- Reflection upon one's practice can be enhanced by another's observations.
- Both observed and observer can benefit from the cycle.
- Teachers are more apt to continue to engage in improvement when they see positive results from their efforts to change.

Theoretical and research underpinnings:
- teacher evaluation (McGreal, 1982)
• clinical supervision (Hunter, 1982; Glatthorn, 1984; Glickman, 1986)
• peer coaching (Joyce & Showers, 1982; Shalaway, 1985)

**Phases of activity:**
1. Pre-observation conference
2. Observation and data collection
3. Analysis of data
4. Post-observation conference

**Illustrations:**
• formal clinical supervision
• informal supervision techniques such as giving praise and encouragement to teachers
• training of teachers in effective instructional practices, followed by training and coaching in classrooms

**Evident outcomes:**
• Teacher behaviors are positively influenced.

**Development/Improvement Process**

Staff development and the improvement of schools go hand-in-hand. (Sparks & Loucks-Horsley, 1990, p. 239)

**Key characteristics:**
• Teachers participate in projects initiated to solve a problem.

**Underlying assumptions:**
• Adults learn most effectively when they have a need to know or a problem to solve.
• People working closest to the job best understand what is required to improve their performance.
• Teachers acquire important knowledge or skills through their involvement in school-improvement or curriculum development processes.

Theoretical and research underpinnings:
• adult learning theory (Knowles, 1980)
• curriculum development as a key element in staff development (Glickman, 1986; Glatthorn, 1987)
• school improvement as a process of innovation, change, and implementation of new practices (Loucks-Horsley & Hergert, 1985; Crandall & Loucks, 1983; Hall & Loucks, 1978; Louis & Rosenblum, 1981)
• school improvement based on research on effective schools (Cohen, 1981)
• school improvement approached through staff development informed by effective staff development practices (Wood, Thompson & Russell, 1981; Thompson, 1982; Wood, 1988)

Phases of activity:
1. Identification of a problem or need by an individual, a group of teachers, a school faculty, or district administrators
2. Formulation of a response
3. Identification of certain knowledge or skills required to implement the response
4. Implementation of a plan
5. Assessment of the success of the effort in meeting the original need

Illustrations:
• teachers developing or adapting curriculum
• teachers designing school improvement programs to meet goals
• teachers engaging in systemic school improvement processes that have as their goal the improvement of classroom instruction or curriculum
Evident outcomes:

- A combination of teacher learnings results from teachers' engaging in reading, discussion, observation, training and/or trial and error.
- Desired outcomes are achieved, provided factors that support such improvement issues exist, such as commitment to the process by school administrators, development of knowledge and skills by teacher participants, and adequate resources.

Training

Training is a powerful process for enhancing knowledge and skills. . . . Because of a high participant-to-teacher ratio, training is usually a cost-effective way for teachers to acquire knowledge or skills. (Sparks & Loucks-Horsley, 1990, p. 241)

Key characteristics:

- Workshops are presented by experts who determine the workshop content for the purpose of delivering a clear set of objectives, such as enhancing awareness and knowledge, developing skills, changing attitudes, and transferring training to classroom practice.
- The trainer selects activities that will help teachers achieve the desired outcomes.
- Teachers are trained in a repertoire of practices to be selected and used appropriately.

Underlying assumptions:

- There are behaviors and techniques worthy of replication by teachers in the classroom.
- Teachers can change their behaviors and learn to replicate behaviors in their classrooms that were not previously in their repertoire.

Theoretical and research underpinnings:

- effective teaching practices (Sparks, 1983)
• combining training components, such as exploration of theory, modeling and practice of the skill under simulated conditions, feedback about performance, and coaching in the workplace (Joyce & Showers, 1988)
• training that includes discussion and peer observation (Sparks, 1983)
• the value of peer-teachers as trainers (Sparks, 1983; Wu, 1987; Wood & Kline, 1987)
• the effectiveness of expert trainers (Crandall, 1983)

Phases of activity:
• determination of training objectives, duration and location of the training, and selection of trainers
• observation of existing teaching behaviors for the purpose of diagnosis
• training activities
• small group discussion and collegial problem solving during training
• in-classroom assistance with peer observation and coaching

Illustrations:
• Training participants learn to explain the five principles of cooperative learning.
• Training participants learn the appropriate use of open-ended questions in a class discussion.

Evident outcomes:
• Teachers acquire new knowledge and skills and use them in their instructional practice.
• Student achievement, attitudes, or behavior improves.
Inquiry

The most effective avenue for professional development is cooperative study by teachers themselves into problems and issues arising from their attempts to make their practice consistent with their educational values . . . [The approach] aims to give greater control over what is to count as valid educational knowledge to teachers. (Ingvarson, 1987, pp. 15, 17, quoted by Sparks & Loucks-Horsley, 1990, p. 243)

Key characteristics:

- Teachers engage in research concerning their own practice, formally or informally, alone or with colleagues or researchers, in their own classrooms or in a university setting.

Underlying assumptions:

- Teachers have the ability to formulate valid questions about their practice and to seek objective answers to those questions.

Theoretical and research underpinnings:

- teaching as reflective action (Dewey, 1933)
- teachers as action-researchers, as scholars, as innovators, as participant observers (summarized by Zeichner, 1983)
- interactive research and development by teachers, researchers, and developers (Tikunoff & Ward, 1983)
- teacher collaboration to pursue answers to school problems (Lieberman, 1986)
- collaborative research, classroom action research, teacher support groups (Watts, 1985; Simmons & Sparks, 1985; Glickman, 1986; Cross, 1987; Glatthorn, 1987; Loucks-Horsley et al., 1987; Sparks & Simmons, 1988)

Phases of activity:

1. Identification of a problem of interest
2. Exploration of ways of collecting data
3. Analysis and interpretation of data, individually or in a group
4. The making of changes, the gathering of new data, and the determination of the effects of the intervention

Illustrations:
- forms of inquiry "limited only by the imagination" (Sparks & Loucks-Horsley, p. 244)
- ethnographic studies of classrooms
- classroom action research
- teacher study groups
- graduate teaching degrees designed to help teachers meet their individually identified improvement goals
- substantial overlap with some school improvement processes described in other models

Evident outcomes:
- "can reach beyond the realm of the individual teacher participant and the group to which the participant belongs" (Sparks & Loucks-Horsley, p. 244), for example, by having a school-wide impact on larger, related issues.

A Supportive Organizational Context

Sparks and Loucks-Horsley (1990) identify key organizational factors that influence the success of teacher development initiatives including:
- school and district climate.
- leadership attitudes and behaviors.
- district policies and systems.
- involvement of participants.
They state that, "Research points to a common set of attributes of the organizational context without which staff development can have only limited success" (Sparks & Loucks-Horsley, 1990, p. 245). They continue,

In organizations where staff development is most successful:

1. Staff members have a common, coherent set of goals and objectives that they helped formulate, reflecting high expectations of themselves and their students.

2. Administrators exercise strong leadership by promoting a norm of collegiality, minimizing status differences between their staff members and themselves, promoting informal communication, and reducing their own need to use formal controls to achieve coordination.

3. Administrators and teachers place high priority on staff development and continuous improvement of personal skills, promoting formal training programs, informal sharing of job knowledge, and a norm of continuous improvement applicable to all.

4. Administrators and teachers make heavy use of a variety of formal and informal processes for monitoring progress toward goals, using them to identify obstacles to such progress and ways of overcoming them, rather than using them to make summary judgments regarding the competence of particular staff members (Conley & Bacharach, 1987).

5. Knowledge, expertise, and resources, including time are drawn on appropriately, yet liberally, to initiate and support the pursuit of staff development goals. (Sparks & Loucks-Horsley, 1990, p. 245)

Sparks and Loucks-Horsley (1990) propose that "much remains to be learned about the process by which staff development occurs" (p. 234). In the conclusion of their chapter, they list areas for further study. Of most relevance to this case study are the following:

- *We need to know more about the impact on teachers of blending the models in a comprehensive staff-development program.* How are teachers' attitudes, knowledge, and skills altered when they choose among and blend various models as the means of reaching one or more "growth" goals? . . .
We need to examine staff development as it contributes to teacher professionalism and teacher leadership. These are terms that many believe must characterize our education systems in the future if those systems are to survive. . . . We need descriptive studies of staff development's contributions to these efforts, with special attention to how these efforts influence the conduct of staff development. (Sparks & Loucks-Horsley, 1990, p. 248)

They conclude the chapter with the words,

The need is great for well-designed long-term studies of school-improvement efforts based on staff development. The field of staff development seeks a solid base that moves beyond description and advocacy to a better understanding of those factors that support and improve classroom practice. (Sparks & Loucks-Horsley, 1990, p. 248)

The Teacher Professional Development Program. In examining the TPDP, I see elements of all of Sparks and Loucks-Horsley's (1990) five models; this is significant because the blended approach to staff development:

- made use of the various strengths of members of the planning team.
- respected differences in teachers' needs and learning styles.
- acknowledged that teachers' needs changed throughout the year and allowed the planning team to respond with different strategies.
- lent the endeavor strength and flexibility.

The TPDP developed in what Sparks and Loucks-Horsley (1990) refer to as "the organizational context" of a single school, a context which supported effective staff development.

The Research Questions

This case study examines factors that supported and improved classroom science teaching at Mountainview Community School. It argues that the TPDP's supportive organizational context and blending of approaches in a "comprehensive staff development program" (Sparks & Loucks-Horsley, 1990, p. 247) were essential to the successful outcomes of the TPDP. Stated formally, the two research questions I answer are:
1. What attributes of the Teacher Professional Development Program supported the school's "objective" for improved science instruction?

2. How did the outcomes of the Teacher Professional Development Program relate to the achievement of the school's educational objective?

The Research Method

My Participation

My research interest prior to the beginning of the TPDP was general, in the sense that I did not have a specific set of research questions or a research agenda separate from the school-designed program. At that time, I knew only that I wished to write a naturalistic case study (Lincoln & Guba, 1985) about the program. The vice-principal's invitation to me was to be a workshop facilitator, and so I felt that my primary responsibility when visiting the school was to support the program; all of my visits to Mountainview Community School were for this purpose. I decided to become fully involved in facilitating the program, to gather data throughout the year, and to make sense of it after the TPDP was finished. I presented myself to school staff as a program facilitator, but I informed them at the beginning that I intended to write a case study and they granted me prior permission to collect and use data for my research.

I followed Merriam's (1988) guidelines in data collection and analysis. Specifically:

1. I collected data during the TPDP and focused my attention on aspects of the Teacher Professional Development Project (TPDP) which particularly interested me, including: the approach to teacher professional development taken by the program planners, the approach to learning evident in workshops and on support days, the support for the program, and the TPDP outcomes.

2. I organized the data into a case study data base (as described by Yin, 1989) at the completion of the TPDP to make the data accessible during intensive analysis. Of particular note to the reader is the identification of informant interviews, which have
been labeled with the initials of the informant's name or pseudonym, a symbol identifying the kind of document, and the date on which the particular item of information was supplied. The originals were collected as field notes, which have not been reproduced in their entirety.

3. I consolidated, reduced and integrated data and looked for patterns and regularities in events that happened frequently during the program. I sorted chunks of information and episodes into situational and thematic categories (parental pressure, ownership of the program, collaborative planning, shortage of time...).

4. I developed conceptual categories that formed the basis for data interpretation (need, leadership, support...).

5. I made inferences and wrote this document.

My influence. My contributions to the TPDP as a member of the planning team had a direct impact on teacher professional development at the school. However, my presence as a researcher, taking notes and recording conversations, lent an aura of significance and importance to the TPDP and to participants' actions and remarks. This could very well have promoted attention and reflection beyond what might have occurred had the TPDP not been the object of a case study.

Data Collection

Without specific research questions formatted prior to the project's beginning, I tried to record anything and everything that occurred as a regular part of the TPDP, with minimal disruption to workshops and school proceedings. I collected data continuously, as best I could without compromising my role of teacher professional development facilitator. Data include audio recordings of planning/debriefing sessions, some workshop discussions, and interviews (25 hours); written summaries of informal conversations with participants and parents; field notes of workshops (30 hours); snapshots of two workshops and bulletin board displays; written classroom observations (10 hours); a survey of
teachers' opinions about the TPDP; and documents relating to the school accreditation process in 1994-95.

Meetings and conversations. Typically, I kept a tape recorder running during planning/debriefing meetings with the other members of the planning team. I conducted and recorded interviews with teachers, alone or with the professor. These interviews focused on the teachers' classroom teaching or their participation in the TPDP and were intended to enhance teacher professional development. For example, when I spoke with teachers concerning their understanding of the changes they saw in their children, our conversations were for the purpose of reflecting on classroom practice rather than answering questions prepared ahead of time for the purpose of my research. There were two exceptions: in February, 1994 when I spoke with the vice-principal about his perceptions of the origins, design and outcomes of the TPDP, and in May, 1994 when I invited teachers to participate in a roundtable discussion to share their views about the TPDP. Informal conversations with the administrators, the professor, and teachers took place on a regular basis during the school year as part of the program. These I summarized, along with incidental parent comments, at the end of each day.

Workshops and classroom visits. I was often actively involved in facilitating the TPDP. I recorded a few workshop discussions related to science teaching or the running of the TPDP, but usually made field notes to which I referred when writing an observation or summary when I returned home. When I worked with teachers in classrooms, I recalled and summarized the day's events as observations.

A survey of opinions. In June, 1994, the vice-principal devised and circulated a survey of teachers' opinions concerning the design, implementation, and outcomes of the TPDP. The survey combined quantitative and qualitative techniques (see Appendix A for the complete questionnaire). I have some reservations about using the quantitative data from the survey due to the wording of the questions, for the questions could be interpreted in a
number of ways, yielding unclear results and questionable conclusions. For example, a question asked,

8. A project of this nature should improve student attitudes toward science. To what extent do you feel this project contributed to improved student attitudes toward science? (select one response):

- a great extent
- some extent
- very little or none
- question does not apply to my assignment

A respondent checked "some extent" and added a comment: "K's [kindergarten students] are enthusiastic already." For me, the comment changes the meaning of the check mark. Similarly, a question regarding the impact of the TPDP on the amount of time students spent on science was confusing.

5. To what extent did the Science Project have an impact on the amount of time your class spent on science?

- a great extent
- some extent
- very little or none
- question does not apply to my assignment

A respondent checked "some extent" but commented, "Enjoy teaching science anyway"; again the intention of the response is unclear. However, teachers wrote some interesting comments which augment comments they made in interviews, and to which I refer in this case study.

School accreditation documents. Mountainview Community School underwent the school accreditation process in the school year following the TPDP, 1994-95. The resulting reports of the internal and external teams give "insider" and "outsider" views of the school program following the TPDP, including its performance in science instruction.
Organization of Chapters

In the next chapter, I introduce the reader to the Teacher Professional Development Program by answering the question "How and why did this program come to be in this place and with these participants?" In chapters 3, 4, and 5, I answer research question #1, "What attributes of the Teacher Professional Development Program supported the school's "objective" for improved science instruction?" In chapter 6, I answer research question #2, "How did the outcomes of the Teacher Professional Development Program relate to the achievement of the school's educational objective?" In chapter 7, I summarize the findings of the study, discuss issues arising from two TPDP features, whole staff participation and school-university collaboration, and suggest areas for further research.
CHAPTER II

THE PEOPLE, THE PLACE, THE PROGRAM

In October of 1993, a university professor and I parked in front of an elementary school and started to unpack the trunk of the car. This was the first of our many visits to present a series of workshops to the teaching staff. The school's vice-principal strode briskly into the parking lot, a big welcoming smile lighting his face; "Gosh, am I glad to see you. I've been watching out for you, first with anticipation and then with anxiety." And we were an hour early! (OB931006).

The professor and I had committed to an ambitious undertaking; we were breaking new ground, as far as we knew, in teacher professional development in science in British Columbia. A long term collaboration between a school and a university to achieve a school objective, with an opportunity for teachers to receive course credit from The University of British Columbia (UBC) for their participation, was an innovative approach to teacher professional development in science. This program, to be the research focus for my dissertation, promised to remedy the shortcomings I had perceived during my own prior experiences as receiver and provider of teacher inservice activities in science. The professor was hopeful about the program but knew this new ground was fraught with uncertainties, ambiguities, perils and potential for disaster. He often commented that you can't please all of the people all of the time, and yet that seemed to be the expectation of the program. I was more optimistic, an optimism originating in ignorance. How had we come to be together on this lovely October afternoon?

The People

When the professor, that is, Bob, and I met the vice-principal in the parking lot, it was as old friends. I had known Steve (a pseudonym), the vice-principal of Mountainview
Community School, for a number of years, as had Bob; Steve was our bridge to the school. Bob and I did not yet know the principal, Nick (also a pseudonym), well but he joined the professor, the vice-principal, and me to form the planning team. Together we embarked on this great adventure, the Teacher Professional Development Program (TPDP).

For ease in reading this account, I generally use personal names but refer to our coalition as the planning team. When I refer to individual teachers, I call them by pseudonyms. When citing quotations in text, I have replaced references to people's names with their pseudonyms. I decided it was not necessary to call individual children by name, even though their names are available to me, because in this document I refer to children infrequently. When referring to the curricular area of science as taught in elementary schools, that is, "school science", I generally say simply "science", for this is the word preferred by teachers and administrators, the word appearing in the school growth plan, and the word as it is used in curriculum documents and research studies (Science Council of Canada, 1984; Bateson, Erickson, Gaskell & Wideen, 1991). So, for example, when teachers described that they were doing more science with their students, the meaning was that they were spending more time on school science, that is, instruction in the curricular area of science.

The Vice-Principal

I first got to know Steve about 5 years previously when we served together for 2 years on a Ministry of Education committee updating the elementary science curriculum. I was drawn to him by his boundless energy and enthusiasm and his warm heart. His quick, logical, and fair mind and buoyant sense of humor were a delight to me. After the curriculum committee disbanded, he and I kept in loose touch; we saw each other only a few times but each time we seemed to pick up our conversation where we left off. When he heard that I had been accepted for graduate study at UBC, he asked something like, "Have you met Bob Carlisle yet? You'll really like him. And he will really like you! You
two are so much alike; be sure to get to know him." My graduate advisor turned out to be, yes, Bob, and Steve was correct in his prediction; we took to each other immediately.

The Professor

Steve knew Bob for several years prior to the TPDP. Steve wrote a major paper for a master's degree in education at UBC analyzing the District Elementary School Science Improvement Project (DESSIP, a pseudonym), a teacher professional development program that he had undertaken with Bob. They worked together for a school year in Steve's school district, running a series of after-school science workshops for intermediate teachers. That experience, along with other projects in which Bob and Steve were individually involved, had a significant impact on Steve's planning of the TPDP (OB931006) and, when Steve asked Bob to collaborate on this particular program, he accepted.

The Principal

While Nick was a stranger to me prior to the TPDP, he and Steve knew each other well from working in the same school district for many years (CL940119). In a planning meeting prior to the first workshop (PL930917), Nick described how, during his first year as principal at Mountainview Community School, he tried to persuade Steve to join him, for he thought there was a weakness in science at the school and he intended to do something about it. They liked each other tremendously and Steve's strength in science was a factor in his being hired. Early in Steve's first year at the school he devised the TPDP as a strategy to address concerns about science instruction.

Myself

In early spring of 1993, when Bob proposed that I become involved in the TPDP, I was immediately interested, for I was a first year graduate student in search of a project suitable for a doctoral dissertation. I knew that much thinking had gone into Steve's preliminary design for a year-long staff development program. I knew two of the three
other members of the planning team and both liked them personally and respected them professionally. In short, I thought this would be a very interesting year.

I wrote about my research interests when I applied to my school district for educational leave so that I could enroll in graduate school. My comments reveal my vision of classroom science, my concerns about the marginalization of science in elementary classrooms, and my interest in teacher professional development:

My love of science has flavored my sixteen years in the classroom. I have developed beliefs about what is most important in teaching science -- that it should start with the child's immediate world, be "hands-on", be taught with enthusiasm, and model sound environmental attitudes. Science is a marvelous way to involve children in studying the world and human interaction with its systems, and give them much to think about creatively and critically . . . . My beliefs about the importance of science are strong but I find myself uneasy about the steady increase in a teacher's responsibilities . . . All too often science seems to drop out of an already crowded day. How can we give everything its due? . . . How can we find the time each day to give "sciencing" the importance it deserves? [In graduate school] I hope to examine factors that influence the enthusiasm with which a teacher approaches science as well as the deterrents to effective teaching. I want to find ways for the typical teacher to make science a strong and lively part of classroom studies. (Brooks, 1992, application for educational leave)

In short, I wanted to find out why science education played such a limited role in many elementary classrooms and learn effective ways to address this situation.

Graduate school. Now, near the end of my first year in graduate school, my son was in Grade 2. My husband ran his business from our home; his flexible hours freed me to spend long days and some overnights at UBC, more than an hour's drive from our home. I was interested in doing qualitative research on teacher professional development in science and I directed my coursework towards that end. I acted as faculty advisor for student teachers during their practicum experience in the Fall, 1992 term and learned much from working with them and their school advisors. I next taught a class in science methods to a different group of pre-service primary (Kindergarten - Grade 3) teachers. Despite their enthusiasm at the end of our 8 week course, I had misgivings about their upcoming classroom practicum, for I knew that most of these student teachers would be placed with school
advisors who taught science, if at all, only as a small part of a language arts theme. I felt pessimistic as I considered some of the problems facing these beginning teachers as they embarked upon their careers with little practical classroom experience in teaching science.

**My hopes.** With the particular challenges of activity-based science, of materials and mess, of noisy involvement of eager children, and of open ended exploration which seems to go in many directions, teaching science can be nearly unmanageable for the inexperienced teacher. I know teachers who have little affection for school science and a deeply felt insecurity about their own science understandings. I wished to provide such teachers with enjoyable inservice activities that they would want to share with children.

**My introduction to fieldwork.** When I first heard of the TPDP, Bob and I were working together on a small research project at an elementary school investigating a group of Grade 7 children's understandings of magnetism as they solved problems using hands-on materials. We worked together to satisfy our curiosity about children's learning in science. This was an interesting and fun project for me, with a professor whose approach to elementary science education I found intriguing. This was an effective way for me to engage in fieldwork and learn something of case study research, for we videotaped the children's work and our interviews with them, and talked about the videotapes later. Our experience together gave Bob an opportunity to see whether or not I was someone he would like to work with on a grander scale. When the possibility of working together at Mountainview Community School arose, I was enthusiastic, and equally enthusiastic about working with Steve again.

**The Planning Team**

I consider Nick, Steve, Bob, and myself as the members of the planning team even though teachers played an increasingly important role in planning workshops and leading school initiatives. The team met regularly throughout the year and provided leadership from the early planning to the end of the TPDP.
A harmonious coalition. The relationships among members of the planning team were characterized by mutual trust, shared beliefs, a protocol of open communication, and respect for one another's strengths and professional judgment. Our long-standing friendships formed the foundation of our collaboration. We liked one another and enjoyed each other's company. We found our conversations interesting, thoughtful and funny; our debriefing sessions were lively, sometimes rambling, as we reflected upon one another's comments, added new ideas, and spun off in new directions. Conversations were often punctuated by chuckles or loud shared laughter. We shared similar views on education and teacher professional development, and trusted one another's professional judgment.

Harmony also characterizes the relationship that I have with Bob. I consider myself simultaneously Bob's colleague, his friend, and one of his graduate students, for he is my graduate advisor and a member of my dissertation committee. The professional respect and personal courtesy evident in his relationships with staff members at Mountainview Community School and presented in this document are equally present in our relationship and governed the writing of this dissertation. He has guided my graduate program since my arrival at UBC and acted as mentor as I worked with pre-service and inservice teachers in a number of venues. Our involvement in the TPDP was collegial and, other than acquainting me with the complexities of audiotaping conversations and modeling open-ended interview techniques, he stayed clear of the research process. I have analyzed the data, drawn conclusions, and written this document on my own, submitting completed chapters to him for comment but not for approval of content. I believe that our multiple roles as program collaborators, friends, and graduate advisor/student have not interfered with my writing a fair representation of the TPDP.

Open communication. At the planning meeting in September, 1993 preceding the first workshop, Nick stated that he felt confident about the success of the TPDP, with one important exception:
The only thing that makes me worry in this, the only potential disaster, is if there's a lack of candor. If there's a lack of candor, the potential for disaster is enormous. To me, the only trap in this whole business is if we get down the road a long ways and realize we weren't all together. (N. F., PL930917, pp. 18-19)

Bob agreed; "It's like an infection under the skin that can erupt into a boil before you even know it's there" (R. C., PL930917, p. 19). Steve countered, "I don't think that's a big risk. I think we should enter this thing cheerfully and confidently, because I don't think the risk potential is really all that high" (S. R., PL930917, p. 19).

**Regular contact.** The four members of the planning team spent as much time, if not more, meeting as a group or talking in pairs about the TPDP as we spent leading teacher workshops. At each debriefing meeting, Nick and Steve told Bob and me what took place at the school in the weeks since our previous visit. We reviewed what occurred at the workshop, analyzed events, shared our concerns and insights, made decisions, and planned what to do next.

We often sought one another's views between workshops, too. While at UBC, Bob asked my opinion of things he had in mind for a workshop and we did much tentative planning together. Similarly, Nick and Steve conferred with one another. Bob and I spoke frequently with Steve by telephone between visits. We spent a great amount of time talking in cars, as Nick and Steve commuted together daily some 40 minutes each way and Bob and I traveled together to the school for better than 2 hours in each direction. We ate many meals together and often chatted over a beer after workshops. All this time spent talking about the TPDP strengthened our trust in one another and enriched our friendship.

**Strength from diversity.** The planning team derived strength from the diversity of experience and individual strengths of its members who were knowledgeable about science and science teaching and experienced in teacher professional development. We knew how to entice teachers into science learning and shared a vision for classroom science to promote to teachers.
The professor. Bob had a lifetime of experience to draw upon in planning and implementing the TPDP. After several years of teaching science in high schools and a teachers' college, he was awarded a 2 year research fellowship by the Nuffield Foundation in London, England. He was director of the African Primary Program, Educational Development Center in Newton, Massachusetts for 5 years; he reported on this project in his doctoral dissertation in 1973. He came to UBC shortly thereafter where he has taught both graduate and pre-service courses until the present time.

Bob's wisdom concerning children's science learning developed from first-hand observation and reflection. He spends much of his time in schools, supervising student teachers and working with teachers on small science projects. A number of his graduate students' research projects have studied children's understandings of science phenomena and he worked with the BC Ministry of Education to develop assessment strategies for hands-on science. Children's learning in informal science environments is a particular interest of Bob; he teaches a popular course at UBC on this topic and works closely with staff at Vancouver's Science World, the Vancouver Aquarium, and the Association for the Promotion and Advancement of Science Education (APASE).

Bob has experience in providing teacher inservice outside the university, too. He has presented science workshops in schools and at science education conferences. He was involved in two teacher professional development projects concurrent with the TPDP, one looking at change at the individual teacher's level, and the other at change initiated at the district level. However, Bob had never worked in the context of a whole school staff prior to the TPDP (PL930917).

The vice-principal. Steve has made science a focus of his professional activities for a number of years and has many years of first-hand experience in elementary science teaching and teacher professional development at the school and district level. He has a large repertoire of science activities that he has used many times with children and teachers. In the late 1970s and early 1980s, he served a 3 year appointment as a full-time
school district outdoor education coordinator. He encouraged and assisted teachers of all grades to use the out-of-doors for science and social studies instruction. He wrote newsletters, offered workshops and helped directly about 20 teachers each year with planning and implementing projects. He was the district's science coordinator in the mid 1980s, during which time he worked in partnership with Bob on the District Elementary School Science Improvement Project (DESSIP). Steve learned much about change initiatives from his involvement in programs during those years. He was a member of the BC Ministry of Education's provincial science curriculum committee from 1989-91; the product of that committee's work was the updated elementary science curriculum in place at the time of the TPDP.

The principal. Nick is an experienced administrator. He never spoke directly to me of any extensive experience teaching science, but did mention that he worked in a research and development lab for a large corporation many years before the TPDP, referring to the scientific experiments and tests he did as part of his job (DB931103). His knowledge and enjoyment of science permeated his comments during our conversations and workshops. He valued a strong science program as part of a good school program and recognized that the science at Mountainview Community School was in need of improvement.

Myself. My interest in science predates my teaching career. My father was a high school science teacher and I have many cherished memories of his science demonstrations in our kitchen at home. Science became an important part of my teaching, with much of it taking place in the out-of-doors with primary-aged children. My interest in natural science and environmental education inspired my master's level work in outdoor teacher education (Northern Illinois University, 1980) and my inclusion on the above-mentioned BC Ministry of Education curriculum committee (1989-91), during which time I met Steve.

I have considerable experience in presenting teacher professional development workshops in science and other curriculum areas in individual schools, at district professional development days, and at provincial conferences. Most of these workshops
have had an environmental theme with an emphasis on working out-of-doors with children. At the time of the TPDP, all of my experience was in giving "one-shot workshops"; I had not worked on professional development over a long period of time with a group of teachers. The TPDP was my first such experience and a rich learning opportunity for me.

**A vision for classroom science.** The planning team's considerable knowledge of science and science teaching experience had a significant effect on the vision of science that we promoted in the TPDP. We had taught or had seen science taught effectively in classrooms and believed in its value to children. We enjoyed teaching science and knew it can be more than the textbook/boardwork approach to teaching science found in many elementary classrooms. We were enthusiastic about hands-on science for we knew both the educational benefits of activity-based exploration and the enjoyment it gives both teachers and children.

**A well-thought-out program.** The combined experience of the planning team enabled us to plan a teacher professional development program that had a high probability of success. We planned a program promoting a vision of classroom science as activity-based, fun, and engaging to children, using simple equipment. We knew that teaching elementary science is within the grasp of a typical teacher and were confident that any member of the Mountainview staff could be successful. We knew of the many challenges inherent in teaching activity-based science, such as the organization of materials and the evaluation of hands-on science, and anticipated and planned to surmount such barriers. Steve and I were familiar with *Innovations in Science* (Peturson & McAllister, 1991), the school's science textbook series, and recognized that it would support the kind of science we proposed in the TPDP.

The planning team anticipated variety in individual teachers' needs, kept planning flexible, and used a variety of staff development strategies in the TPDP as needed. We
emphasized a learning-by-doing approach to science and science teaching, believing that it would contribute to teachers' experiencing success in their classrooms.

The planning team also recognized that, if significant and long-lasting change were to occur, a "supportive organizational context" (Sparks & Loucks-Horsley, 1990) was critical. The TPDP must be focused, intense, and long term, with a low personal cost-to-benefit ratio for teachers, and must be adequately funded. We provided classroom support and promoted a norm of collegiality in the program. Towards the end of the TPDP, Nick attributed much of the TPDP's success to our anticipating possible problems and avoiding most of them (DB940316).

Despite our extensive background in teacher professional development and the self-assurance with which we planned and implemented the TPDP, every day was a new challenge. In February, 1994, when we experienced what Bob referred to as "a watershed" (R. C., DB940105, p. 52) and felt that we could relax a bit, Steve somewhat ruefully reflected,

Bob and I thought we learned so much in that District project [the DESSIP] . . . [yet] when we run this project now--if you can even say we run this project, we have become involved in this project--I feel like a complete neophyte! . . . Each time we do one of these classes, we confront a bunch of challenges and we're often quite successful with them but next time, boy, there's a whole new set [of challenges] all over again. (DB940202, pp. 10-11)

The other important participants, the teachers, the children, and their parents, were not yet known to me in the initial planning stages and are represented later in the document.

The Place

Mountainview Community School is located in one of three communities widely spaced along a narrow corridor linked by a provincial highway. The southernmost community is by far the largest, with more than three quarters of the school district's children, and is the administrative center of the district. In 1993 this community had six elementary schools and two high schools. Mountainview Community School was the only elementary school
in a town 45 minutes north and more than 2 hours' drive from UBC; high school students had to travel by bus another 30 minutes to the northernmost community which had one elementary and one secondary school.

Mountainview Community School is in a growing, vibrant community which attributes both its origin and prosperity to its status as an internationally renowned resort. Its population of approximately 5000 permanent residents can double or triple on a weekend, providing year round and part time employment for both residents and commuters. Even during the week, there is much activity in the village and many places to go for a beer or a quiet dinner. If one were to continue driving north, one would see the development peter out and leave the village with little idea of the residential community nestled just over a rise to the left of the highway across from the village. It is here that many of the children at Mountainview Community School live.

The houses in the immediate vicinity of the school are large and imposing, arranged along quiet, winding roads and set against a backdrop of snowcapped mountains. Individual designs seem to take advantage of the rolling landscape. The overall impression is one of affluence and order, of ostentatious good taste, but with little history or tradition or variety. Not all of the houses are occupied during weekdays and there is a bit of a deserted feeling to the neighborhood.

This new, well maintained residential subdivision has ready access to amenities associated with the resort across the highway, and to a good array of social services. Similar developments are burgeoning in the valley, and a second elementary school and a high school are planned to be completed before the end of the decade, justified by the community's increasing population. Daycare is offered after school at a facility located a convenient distance from the school; daycare staff meet the children at the school at the end of the day and walk them back to the daycare site. Other children are cared for at home by nannies. Some children live within walking distance of the school, but many
travel on school buses which remain parked at the school during the day and are available to classes for field trips.

Mountainview Community School was only a year old at the beginning of this study, built on a new site to replace an aging building razed to give way to village expansion. Due to the shape of the land, it seems to sit by itself at the end of a short driveway off a winding road, quiet, surrounded by playing fields and adjacent forest. One approaches the school from the side by driving past a circular garden. A nature loving primary teacher made this garden the location of a class project and her Grade 1 class calls it their butterfly garden. An ample parking lot faces the front of the school. The school is large and of striking design with many large windows. Canadian and provincial flags snap in the breeze. Well-maintained and landscaped and set against a backdrop of mountains, amidst a fragrance of piney forests, the school forms an attractive impression to the visitor.

Double doors open into an entryway and a crosswise hallway. Daylight filters through skylights in the high ceiling. Beyond is a lounge with a fireplace, comfortable sofas and chairs, and a glorious view. This first impression, of space and calm and restfulness, belies the use of the building -- an elementary school accommodating approximately 360 children in Grades K to 7. Some young children must walk from one end of this vast building to the other for gym class; this they do with the teacher in the lead, hands by their sides, not talking, not touching. This seems to be the teachers' expectation for behavior and I saw it again and again on our visits (SF931021).

The lounge hints at a second use -- that of community center for the local residents, and the school describes itself as a community school on the basis of this shared use of space. The community office is in the reception area; its staff arranges public bookings for the rooms which lie along a corridor to the right: the enormous double gym, divided by a storable curtain wall and fitted with a stage, change rooms and washrooms, and a multipurpose room, a large open area with foldable chairs and tables stored along the walls. It was one of the two meeting rooms for our workshops. A second room is used only by
school staff as a Learning Assistance room. We used its three long tables arranged in a horseshoe configuration for the seminar portion of our workshops. Between the two rooms lies a large full facility kitchen.

In the other direction, to the left of the reception area, stretches the classroom wing, behind double doors that are locked at the end of the school day. Stretches, indeed, for the rooms appear to be arranged on either side of a long, straight, rather narrow hallway. The feeling of length is accentuated by the great height of the hallway ceiling, again punctuated with skylights. This one-level school building accommodates 15 classrooms, a library, a computer lab, a teachers' prep room, a sickroom, a photocopy room, a staff room, and service rooms.

The general office lies immediately to the left as one enters the wing; a smiling secretary sits behind her desk, located behind a chest high counter. In the far corner is the principal's office; the vice-principal's tiny closet of an office lies nearly at the other end of the school. A small corridor within the office leads to the sickroom, across from which is located a staff notice board. Daily bulletins, written by Steve, kept staff members apprised of the day's events. Beyond lies a small teacher prep room containing a phone, paper cutter, and the odds and ends that accumulate in corners a school; adjacent is a locked office supplies storage room. Across the hall from the office is a spacious but windowless room housing a huge, expensive, multi-optioned photocopy machine. Ironically, this dark, noisy room is the location of many conversations between teachers as they wait for their photocopying to run off.

Classrooms dominate the rest of the building. Two side corridors accommodate four classrooms each. This arrangement of two classrooms on each side of a corridor seems to form a natural social grouping for those teachers, for the doors are directly across from one another and adjacent rooms are separated by bulletin boards on which children's work is attractively displayed. Similarly, two kindergarten rooms are clustered at the far end of the school, making a social group. The remaining five classrooms are awkwardly placed
along the busy main hallway, their doorways facing nothing in particular, giving them a feeling of isolation. However, two of those teachers have formed a strong working relationship due to their teaching positions rather than classroom placement, for together they are responsible for children enrolled in Programme cadre de francois, the French language program for children of francophone parents. Their classrooms are not far from one another, just flanking the staff room.

The classrooms are what I judge to be of average size, spacious and bright, with large windows that frame lovely views stretching across one and sometimes two walls. Student desks are flat topped and moveable, with detached chairs, arranged in various configurations. Some teachers' desks designate the front of the room but some rooms have an alcove at one end used by teachers for a desk and work area.

The computer room, when busy, gives the impression of bright light and noise. Sound effects from programs compete with one another to fill the room with an electronic din. Computers on long tables line the walls and fill the center of the room; they are networked to a central printer. The adjacent library, on the other hand, gives the impression of cool serenity, with its high ceiling, green plants, low tables, and brightly colored books attractively displayed throughout the room. Large windows at the far end look out not only on the parking lot but beyond to the forest. The library seems well stocked; in browsing through the book collection, I quickly located my favorite children's books and easily located a number of recent non-fiction books in good condition on a number of science topics. A glass cabinet in the hallway outside the library houses appealing displays of books and related artifacts and children's work.

The spaciousness of classrooms is not evident in the staffroom. Whether empty or populated, the room seems cluttered with furniture, leaving little room for the social needs of a staff in excess of twenty. Behind the door is an open coat area which might accommodate six winter coats; within one step, directly ahead, are two wicker armchairs facing two wicker love seats arranged around a coffee table. Another one or two
armchairs are often in the way, obstructing movement. A large automatic coffee and hot water dispenser occupies a low table at one wall, and the remainder of the room houses a very small kitchen. Recess and noontime seem frantic as teachers jostle at the sink or fridge to prepare lunches; typically, teachers as well as parent aides, support staff, and visitors sit tightly packed, leaving little opportunity for quiet conversation. During class time, a teacher might pop in for a cup of coffee, but typically, only the bus driver sits, quietly reading his paper or talking on the phone.

The Program

The TPDP originated in needs identified by school staff, stimulated by a directive from the school district superintendent in Fall of 1992 requiring that each school submit a 3 year school growth plan. The staff targeted science improvement as one of five objectives. Figure 1 shows the features of the 3 year school growth plan concerning science education, devised by the vice-principal and approved through consensus by teachers as a strategy to address the objective.
Science Education

Rationale: Science education in BC is undergoing a major revision to generally update the curriculum and ensure that it is consistent with the Year 2000 concepts. Our new vice-principal, [name deleted], had a hand in rewriting the BC science curriculum and is fresh from leading a very successful science teacher training program in collaboration with the Faculty of Education at UBC. With the vice-principal on board, the Mountainview Community School staff have an opportunity to implement the new science curriculum and improve their own expertise in the teaching of science.

Objective: to improve the instruction of science by making it more frequent, more active and more student-centered.

Strategies: extensive and extended staff development and training
            peer support
            acquisition of materials and equipment
            use of UBC personnel

Responsibilities: major planning and implementation: the vice-principal
                  funding and approval: the principal
                  UBC support

Resources: Wednesday afternoons
           UBC personnel
           capital and operating funds for purchase of science materials

Budget: TBA

Timelines: 1992-93 planning and orientation of staff
           1993-94 first year of staff development and training
           1994-95 second year of staff development and training

Evaluation: to be determined during planning stages
Steve used the first year, 1992-93, to lay the groundwork for the change effort: purchasing science materials and resources, gathering financial support, forming an association with UBC personnel, and setting a tentative agenda for the workshops. Unexpectedly, preparations were also made to enable teachers to receive course credit for their participation. Steve invited Bob to become involved in the middle year, that is the first year of teacher inservice, 1993-94; that is the year detailed in this document and comprised the TPDP. The one year program concentrated the staff's professional development efforts and the school's resources for the school year 1993-94 in the single area of science, for the administrators believed that only such an intensive and extensive effort would be effective (DB940202). The final year, as yet unspecified, was for the continuation of staff development and training.

A long timeline. When the planning team talked about the long timeline prior to the first workshop, Steve pointed out a feature of this marriage between school inservice and university course.

The strength of the traditional university training courses is that they go on over an extended period of time. The weakness is that they occur outside the context of the real job world . . . The strength of professional development activities that take place in schools traditionally is that they occur within that context of the real job world, but the weakness is that they don't, or they hardly ever, occur over an extended period of time. What we are going to try to do here is eliminate those two weaknesses that I just mentioned and put the two strengths together. (S. R., PL930917, p. 34)

All things considered, Nick believed, "This particular model . . . offers the best promise of any kind of staff development that I've ever had any experience with" (N. F., PL930917, p. 6).

Bob also viewed the project at Mountainview School as a promising model for change at the school level:
My experience over the last 30 years of working with whole systems has been that, in fact, what happens is you get little pockets of excellence. So why not work directly with people who really want to work rather than find them by accident? (R. C., CR930917, p. 3).

He sensed the enormous potential of the TPDP, he summarized for me before the first workshop,

When this came up, it was a school that had united in its interest in doing something about science. The whole staff wanted to participate, and linking it with the opportunity to run a course which would give them credit, for this is a project rather than a course, and the added interest, of course, to have yourself collect data and get it documented for your dissertation, there are a lot of very exciting things despite the commitment of time, the distance of traveling and the inconvenience. It is a unique opportunity in my lifetime. (R. C., CR930917, p. 3)

It is not unusual for a school staff to identify an area in need of improvement and to make it a focus for a school year. However, the groundwork carefully laid prior to the beginning of teacher professional development activities, the frequency of workshops, the availability of classroom support throughout the effort, and the exclusive staff focus on professional development in science are, to my knowledge, unique in British Columbia, and distinguish the TPDP from more typical science professional development efforts.

Building on a previous collaboration. As in many enterprises, the TPDP drew upon the prior experiences of members of the planning team. In 1988-89, Bob and Steve collaborated on the District Elementary School Science Improvement Project (DESSIP). They presented a series of ten science workshops to 15 intermediate teachers over a school year. Both Steve and Bob felt that what they learned from the previous project was valuable in informing the planning of the TPDP; the richness of their personal experience was a powerful instructor. The structure of the TPDP built on the strengths of the DESSIP while addressing its concerns. However, the TPDP was different in a significant way; as part of a plan to address a school objective, not only was the TPDP located in the school, but the demand for the year of workshops came from the school staff.

Learning from past experience. The DESSIP was the topic of Steve's major paper for his master's degree. In his paper, Steve concluded that while the workshop structure and
content of the DESSIP were sound, several factors are critical in supporting the
implementation of such an initiative; his conclusions contributed significantly to the early
planning of the TPDP. Support of district administrators and principals is needed, ideally
in the form of active involvement. Key personnel must be maintained to assist in the
continuation of the project. One year seems inadequate for lasting change; Steve referred
to Fullan's (1982) admonishment to "expect significant change to take a minimum of 2 or
3 years" (p. 91). This gives rise to a dilemma concerning time and money: "Put simply, if
the District Project was to do the job properly, it would take too long and be too
expensive. If the project was designed to be affordable, it would provide insufficient time
for effective implementation and continuation" (Price, 1990, p. 59). Bob felt they had
needed more time for it to work, for in education "continually we try to achieve too much;
we think we can achieve a lot in a very short time. Maybe . . . what we needed was two
more years." (CR930917, p. 5).

A final planning concern emerged from Steve's survey of the literature on teacher
professional development included in his master's essay, a suggestion that the school is the
most effective unit of change. The DESSIP involved a number of teachers from each of
seven schools. Two reasons informed this structure. First, planners believed that if
teachers were teaching children of similar ages, they would be more successful in sharing
ideas concerning materials, science knowledge and instructional methods than if there
were a broad range of grade levels. Another reason emerged during discussions with
principals during the year prior to the DESSIP, for principals feared that school-wide
adoption would present problems. Principals felt voluntary participation was preferred but
that it would be difficult to obtain the unanimous consent of staff members. Some
principals were concerned that the adoption of the DESSIP would interfere with existing
school goals. In concluding his paper, Steve proposed that such initiatives be school-based
and planned far enough ahead to allow science improvement to become a school objective.
The TPDP was such an initiative.
Beginnings

The TPDP was planned well ahead of time, as Steve proposed in the conclusion to his paper, as a means of addressing the school objective for science instruction. While not the only objective in the school growth plan, its inclusion made science an important focus worthy of significant commitment, helping address the requirement for time and money. Full administrative support was assured as well, with the principal's keen interest and with the vice-principal acting as advocate for the program. It was highly likely that Steve would stay at the school for the full 3 year period to act as key personnel to assist in the continuation of the project. Practical concerns expressed in the DESSIP report to do with school timetables and appropriate classroom furniture could be better addressed in this school based project than in a district project involving a few teachers at a number of schools. The district teachers' association (the teachers' union) had expressed concerns about the DESSIP removing control of professional development from teachers; with the TPDP as part of the school growth plan developed by the staff, teachers would control the professional development and the support of all staff members was assured. Additionally, Bob and Steve hoped that collaborations among teachers could happen more easily in a program in which all participants were teaching at the same school. This feature was one which they looked forward to developing during the program.

Borrowing from the DESSIP. Steve and Bob planned to present a series of practical, hands-on workshops, similar to those which worked so well in the DESSIP, providing teachers with ready-made materials to try in their classrooms. Steve would act as advocate for the program and be available to help teachers between workshops. Each workshop would include time to discuss teachers' classroom experiences and to plan lessons. Workshops would be after school so teacher release time was not needed. The workshops would cost teachers little in personal time for early Wednesday dismissal time and a reduced frequency of staff meetings saved time. No teacher release time was planned to enable teachers to team teach, observe one another or plan cooperatively. However, Bob
would spend the full day of the workshop at the school and give classroom support to
teachers if they requested it.

Putting the pieces together. By early 1993, Bob and Steve had talked extensively by
telephone and assumed the planned year of workshops was a "go". They suggested that
they would like me involved, and thought that I might use the program as a basis for my
dissertation. With my many years as a primary teacher and experience in running
professional development workshops for teachers, I would be a useful addition to their
partnership, which had worked so well previously.

As these plans took shape, Steve invited Bob and me to visit the school in March of
1993. Steve suggested that we come to the school in the early afternoon, gather
impressions of the school and meet the teachers at their Wednesday staff meeting; the staff
could meet us and "look us over". I was still not sure that I wanted to be involved in the
program, as I was concerned about the time required to travel to a school located at some
distance from UBC. With a full load of graduate courses planned for the next year, I was
conscious of my family commitments. But I accompanied Bob, both to see my old friend,
Steve, and to get a sense of what this program would be like.

I discovered that, indeed, the school was at some distance, a more than 2 hour drive
from the university and a further hour from my home in the Fraser Valley; each visit to the
school would make for a very long day.

First Encounters

The Program Participants

I met the principal of Mountainview Community School for the first time that day. My
impression was of a tall, strong leader with a firm handshake and a welcoming smile.
Nick's posture conveyed a sense of his position as principal of Mountainview Community
School and an awareness of his responsibilities, a team player with the high probability
that he would be captain: a leader. He appeared confident and deeply committed to the
children and staff. I soon came to appreciate his sardonic sense of humor which he used frequently to dispel tension. Only after I got to know him better did I discover that he was an astute observer of people and that he reflected deeply upon what he saw.

As I scanned faces at the staff meeting, I saw the composition of the staff with whom we would spend the following year. I was not surprised at what I saw, for this elementary school staff, about twenty in number, was very much like those I had taught with or worked with -- predominately women about my age, a few younger teachers at the beginning of their careers, and the two middle-aged male administrators.

The Teachers

Once the TPDP began, I got to know the teachers better. The staff included 15 classroom teachers: five intermediate (Grades 4-7) teachers, Teresa, Leanne, Marion, Kelly and Craig, plus Lily who taught a split grade 3/4; six primary (Grades 1-2) teachers, Hans, Trixie, Jill, Elizabeth, and Tilly, plus Nancy, a teacher-on-call on a long-term assignment teaching Trixie's class while Trixie was on educational leave; a kindergarten teacher, Evelyn; and Jacqueline and Marjolaine, the two Programme cadre de francais teachers who together provided full time French language instruction for francophone students from kindergarten to Grade 7. In addition to the classroom teachers were five so-called "non-registering teachers", that is, teachers not attached to a specific class of children: Frances, the teacher-librarian; three learning assistance (LA) teachers who provided support to children with special needs, Bonnie, Tammy and Trudy; and Kay, a teaching assistant hoping to become a teacher some day.

UBC Personnel

Steve introduced Bob and me as his good friends and colleagues from UBC with whom he had worked before with great enjoyment, with Bob on the District Elementary School Science Improvement Project (DESSIP), and with me on the provincial science curriculum committee. He told the teachers Bob and I would be willing to work regularly with the staff to help them address their school objective of improving science in the
classrooms. He added that I would like to use the program as the topic for my dissertation. Steve asked the teachers to express their opinions about how we could best facilitate their reaching their objective of improving science instruction at the school.

The teachers' wishes. The teachers requested mini-workshops demonstrating simple hands-on activities, perhaps short snappy activities that could be used with children on a weekly basis. Teachers wanted to become more familiar with teacher resources for science, both texts and other books, and to go through the science equipment at the school and learn how to use what was there. They expressed satisfaction with their recent school science fair; they hoped for more involvement on the part of the children, with more teachers helping with the planning the following year. They wanted to identify experts in the community, perhaps including parents, to enrich their science program. Several teachers expressed concern, which was already evident in their previous remarks, that they didn't know much about science; this made them feel unsure about methods of evaluating for the purpose of writing report cards.

Although Steve's proposal was presented as a *fait accompli* I sensed that he was seeking the agreement of the teachers to proceed with the program. The teachers seemed on the whole relaxed, friendly, and curious, but it seemed to me that a few eager teachers did much of the talking while others sat and watched. Then the unexpected happened, the first challenge to the carefully considered design of the year of workshops. A teacher rather tentatively raised her hand and stated that she was enrolled at UBC as a part-time student. She wondered if she might be able to do some work during the year and get course credit by doing a directed study. Immediately a number of other teachers brightened and sat up a bit straighter. Without missing a beat, Bob responded that he was quite flexible and didn't see why not. How many others might be interested? Almost a dozen hands went up.

University at a distance. This interest was not surprising to me considering the distance of the school from university campuses in Vancouver. Course credit accumulation is a
slow business on a part time basis for teachers living in remote areas of the province; they are generally limited to taking summer courses, which usually entails moving to Vancouver for 3 to 6 weeks. While some Mountainview teachers enjoyed this break from the responsibilities of family life (T. N., KS940421), the opportunity of being able to earn course credit right at their school was attractive. As Teresa explained during the TPDP,

It's really hard to take courses up here . . . I've been trying to work on my masters' degree, I've started . . . [but] having a family and kids and keeping myself active, it's really hard to do it. I've been accepted, I've pulled out, I've been accepted, I've pulled out, because I just can't get down there [to the UBC campus]. My husband works for the resort municipality and he has no desire to live in the city, to go in summer schools, but I have my kids and I wanted to spend time with them, they grow so fast . . . so I thought I'd take this course. (T. F., S940203, p. 2)

Bob turned to me and asked whether I would be interested in being fully involved in providing staff development with him and I instantly agreed, as I was favorably impressed by my visit. Our introduction wrapped up quickly with Bob's promise that he would look seriously into the possibility of offering credit for interested participants through Distance Education at UBC (now called Continuing Professional Education). We excused ourselves from the staff meeting with the intention that we would return in a few hours to join Steve and Nick for dinner at a local restaurant. Bob and I left the school feeling elated at our warm reception and stunned at the turn of events. Was I really interested? Yes indeed. We celebrated over a pint of Guinness at a local bistro; Bob bought.

The Year

The TPDP consisted of:

- eleven 2-hour workshops held after school, spread over two school terms (from October, 1993 to May, 1994).
- two professional development days (October 25, 1993 and March 18, 1994).
- classroom visits by members of the planning team, during the school day, on teacher request.
• teacher release time during the school day for conferencing and planning, on teacher request.
• planning team debriefing sessions after workshops.
• data collection for this case study.

Workshops

Workshop content varied from workshop to workshop in response to teachers' stated needs, and included some or all of the following elements:
• teacher engagement in one or more hands-on science activities, demonstrated or facilitated by members of the planning team (see Appendix B for a description of these activities).
• discussion of science concepts underlying workshop activities.
• presentations by invited speakers.
• discussion of readings assigned by the planning team.
• sharing of teachers' classroom experiences of teaching workshop activities and trying new teaching approaches.
• discussion of problems and issues related to teaching science at Mountainview Community School.
• planning the agenda for the next workshop.
• science unit planning time for teachers.

Professional Development Days

Two of the school's provincially mandated professional development days were devoted to the TPDP and were used to introduce teachers to stand-alone science education support programs:
• Project WILD, a resource program consisting of a number of activities teaching environmental concepts (BC Ministry of Environment, Lands and Parks).
• Power Smart Programme, an instruction kit teaching energy concepts and conservation (BC Hydro, undated).
Classroom Visits

Bob and I stayed overnight in the community following all workshops except the first and the last. Teachers signed up to request classroom visits during which we assisted teachers in any way they wished. I refer to these days as "(Thursday) classroom support days" and to these visits as "classroom visits". Similarly, Steve visited classrooms in the days between our visits. During these visits, we:

- demonstrated activities to children while teachers observed.
- observed teachers as they introduced workshop activities to their children.
- spent time visiting classes in a more general way, as when I accompanied a primary class on a visit to the local health clinic, or when Bob interviewed individual intermediate children about their science fair projects.

Teacher Release Time

Starting in January, 1994 TPDP funds were used to hire teachers-on-call (substitute teachers) to provide teachers with release time on classroom support days. Typically, one or more teachers-on-call were hired on a single day; each would release a number of teachers in succession throughout the day for approximately one hour. Teachers used this time as they wished. They:

- conferenced with members of the planning team.
- planned their science programs, alone or with other released teachers.

Planning Team Debriefing Sessions

The planning team met after the workshops to:

- debrief workshop events.
- share observations and insights.
- inform one another of occurrences since the previous workshop.
- plan the next workshop.
- make program decisions.
These sessions were typically attended by the four members of the planning team: Nick, Steve, Bob, and me. Two of the sessions were dinner meetings; most were held in Nick's office; Bob, Steve and I met once at UBC. Towards the end of the TPDP, as the teachers assumed leadership for planning workshops, the planning team sessions were less formal and took place over a glass of beer in a local bar or were omitted altogether.

These planning team sessions were in addition to a pre-TPDP planning meeting, numerous telephone conversations, informal snatches of conversation at the school, and extended conversation in cars, as Nick and Steve commuted together to work and Bob and I traveled together to and from the school.
CHAPTER III
THE CHANGE PROCESS: A COMPELLING NEED AND A STRATEGY FOR IMPROVEMENT

Sparks and Loucks-Horsley (1990) discuss the importance of a supportive context for educational improvement initiatives. Among the attributes shared by endeavors that have been successful are:

- a common coherent set of goals and objectives that staff members help formulate, reflecting high expectations of themselves and their students.
- a norm of continuous improvement applicable to all, in which administrators and teachers place a high priority on staff development.
- a combined top-down and bottom-up approach to planning with teacher involvement in key decisions about staff development and the design of appropriate activities.

Mountainview Community School provided such a supportive context. These attributes are evident in the identification of science instruction as being in need of improvement; in its inclusion as an objective in the school growth plan; and in the design of the TPDP as a strategy to help staff meet their objective, a program emphasizing staff development.

The TPDP developed in response to a compelling need identified by school staff, who designed a program to meet their needs. The particularity of the school's improvement effort was a feature of the TPDP; its origin and design distinguished it from more typical initiatives in science instruction improvement which originate in needs identified by district or provincial personnel, who set objectives, design programs, and implement them in a number of school settings. This "one size fits all" approach to professional development does not take into account the particular needs of school staffs nor does it enable teachers to direct their professional development and take ownership for the changes.
A Compelling Need for Change

The school staff identified the need for change, a) in a climate of contemporary beliefs about the importance of scientific literacy to children; b) following an examination of the adequacy of the school system to contribute to this literacy; c) at the time of the introduction of an updated provincial science curriculum; and d) upon examination of the school's science program vis-a-vis these new directions.

The Importance of Scientific Literacy

Local institutions such as Vancouver's Science World and the Vancouver Aquarium, science textbooks, and popular television shows such as Bill Nye the Science Guy, promote the importance of science to our youth and emphasize hands-on involvement in science learning. Such messages are heard by teachers who worry that their science instruction does not include enough hands-on science activities, and by parents who view their children's classroom experiences critically and sometimes judge them as inadequate. Recently developed teaching materials such as the school's science textbook series, Innovations in Science, add to the expectation that classroom science instruction should be activity-based.

Examination of the Educational System

Science Council of Canada (1984). In 1980, the Science Council of Canada began an examination of the ability of Canada's educational system to create scientific literacy for all Canadian students. In 1984, the council concluded, "Canadian students need more and better science education to prepare them for the future. Renewal in science education is essential" (Science Council of Canada, 1984, p. 9). In Report 36, Science for Every Student: Educating Canadians for Tomorrow's World (1984), the Science Council examined the intended and taught curriculum, and identified problems including:

- the unavailability of curriculum resources.
- inappropriate evaluation methods.
- an imbalance among attitudes, skills and content.
• insufficient allocation of time to teaching science.
• inadequate preparation of elementary teachers to teach science.
• inadequate facilities for science teaching in the early years.
• few opportunities for relevant science inservice.

British Columbia Science Assessment Provincial Report (Bateson, Erickson, Gaskell &
Wideen, 1991) echoed the 1984 findings of the Science Council of Canada. The report
states that, while some teachers provide their children with a lively and worthwhile
program, science has been marginalized as a subject in many British Columbia classrooms.
Many teachers do not value science, or teach science through lecture and recitation
without engaging children intellectually. Respondents identified many problems including:
• insufficient class time devoted to science, particularly at the lower grades.
• a lack of science coordination at the school and district levels.
• a lack of emphasis and support for science teaching at the district level.
• poor pre-service teacher education in science.
• inadequate professional development in science.

BC school district science leaders. In 1994, 3 years after the Ministry of Education's
assessment, 127 representatives of British Columbia school districts attended an
elementary science leadership forum. They responded to a survey (Brooks, 1994a)
inquiring about the teaching and learning of science in their school districts. The results
indicate that little had changed in the years since the previous reports. Respondents
identified ongoing problems including:
• inadequate teacher inservice opportunities.
• insufficient funds for science equipment and expendables.
• insufficiently detailed science curriculum.
• a lack of up-to-date teacher resources and student texts.
Interestingly, in January, 1994 the Mountainview Community School staff independently identified the same problems as having an impact on their science teaching.

An Updated Provincial Science Curriculum


Children develop an understanding of science as they investigate and interact with real objects and phenomena. Approaches should include hands-on, activity-centred experiences that consider the interests, abilities, and needs of children. "Sciencing" -- the active process of science -- is learned, not taught. Children should be provided with a variety of opportunities for play, questioning, exploration, 'messing about', demonstration, investigation, and experimentation. Themes and supporting activities should be: learner-centred, activity-centred, modelled by teachers. (pp. 318-322)

The Mountainview staff examined the school's science program with reference to these new directions and to parents' expectations and found it lacking.

Examination of Mountainview's Science Instruction

Mountainview's school growth plan. The district superintendent of schools' requirement that all schools submit a 3 year school growth plan, along with concerns expressed by parents of Mountainview children, hastened the staff's decision to address the need for science improvement. The school growth plan stated that, when considering what to include, the staff took into account commitments and projects in progress and changes mandated by the Ministry of Education. It also capitalized on the availability of a staff member experienced in professional development, the vice-principal.

The staff selected five areas for inclusion in the school growth plan: integration of special education children, assessment and evaluation of student progress, implementation
of the new computer lab, improvement of social and interactive skills in children with behavioral difficulties, and science instruction. Steve summarized,

Almost every school could make a list of five or six major things that they need to work on, and I suspect that at that point science was just one. And then it wasn't until you realized that an opportunity may be presenting itself by adding a staff member who was interested in science that then science began to creep to the top of that list, just because it was one that you might be able to address more effectively. (S. R., PL930917, p. 12)

Objectives for the first four areas were planned to reach completion by June of 1993 and only science instruction was to be addressed in the school year 1993-94. Thus, the TPDP was the only teacher inservice planned for the school year 1993-94.

The principal's concerns. Nick saw a need to improve science instruction earlier, when he was appointed to the school and was eager to have Steve come to Mountainview Community School, as

One of the strengths he demonstrated since I first knew him in the district was an incredible affinity for science and sciencing. And I thought at that time that if I was ever so lucky as to get him convinced that he'd want to come here, we could have the best darn science program in the district. And as coincidence would have it, the parents here had spotted early on that one of the weaknesses in the school was a lack of science and what they regarded as science ... Generally they're well educated and they understood that science ain't a textbook -- Science is a way of thinking and a way of doing. Science involves doing, and so when their desire for doing and his expertise ended up in the same building, it was history after that. (N. F., PL930917, p. 11)

Parents' concerns. The administrators believed that parental criticism helped them make science a focus for professional development. Nick commented,

It could be that our timing was exactly right because of the hue and cry in the community which was getting louder and louder. And one of the things we did say to the staff was, "I have been to the PAC [Parent Advisory Council] and I wish to report that one of their concerns in this school is science education". (N. F., PL930917, p. 29)
Teachers acknowledged that improvement was needed and looked for a way to respond to parents' concerns (KS940421). As Bonnie explained,

> We had a great deal of pressure from the parents at the school . . . . There was some sort of notion that we weren't doing a good job of teaching science and maybe we were, maybe we weren't. I don't know because [as a learning assistance teacher] I never paid any attention really to what people were doing in science. And it just brought . . . a sort of low grade paranoia that we weren't doing a good job in this area. (B. F., EJ940421, p. 2)

In Steve's judgment, the parent body included many intelligent, well-educated people who took an active interest in their children's education (S. R., DB931103). Their active interest inspired a parent volunteer program much appreciated by teachers (T. N., SI940421), but some parents' active interest was viewed as critical, threatening, and unsupportive of teachers' efforts (T. N., KS940421; M. N., LG940407; B. F., EJ940421; M. Y., JL940421; K. D., LJ940421; T. F., RT940504; T. D., SF931021). This parent body made the school something of a pressure cooker for teachers. As Nick described it,

> Some teachers will not go near this place because they perceive it as very very high pressure and very much a fish bowl. Others come in here because they perceive an opportunity to be recognized for their talent and ability, and others come in because of what they perceive to be the atmosphere . . . . The positive side of it is that if you do something right, the praise [from parents] is meaningful praise because it's praise from people who don't praise lightly, but praise intelligently. (PL930917, pp. 28-29)

When Bob proposed to Trixie that, in this community, achievement would be home-driven and that expectations would be high not only for student achievement but also for teacher performance, she agreed and added that the parents' attitude was "Give us what we want" (T. N., KS940421, pp. 18-19). However she added, "You know, on the whole, really all these parents want . . . is the best for their children. And I don't see anything wrong with any parent wanting the best for their kids" (T. N., KS940421, pp. 19-20).
The principal viewed some parents as being genuinely interested in high quality education for their children, but he viewed other parents as "trouble makers" and "critics" (N. F., DB931103, p. 43). The latter parents aired their complaints at the monthly Parent Advisory Council (PAC) meetings at which typical attendance was no more than 10 to 30 parents, and usually less than 10 (S. R., DB940302), some 10% of the parents in the school community (DB931103). Both administrators attended these meetings but few teachers attended regularly, other than teachers whose children attended Mountainview Community School. Active and vocal members of the PAC spoke as though they represented the parent body, and were uninhibited about stating their views. Nick was particularly aware that effort put into public relations by the administrators at PAC meetings would benefit the staff's position with both supportive and critical parents, and he regularly communicated the progress of the TPDP at these meetings. Nick and Steve presented the TPDP as

Effective learning by teachers which will be translated into effective teaching in the classrooms . . . We talk about the substance of what's going on here and why this is effective, and why it's necessary, and why it's good. (S. R., DB931103, p. 45)

I formed the impression that teachers tried to be responsive to parents' concerns and tried to please them. On one occasion, Lily told me that she put together a homework unit on seashells for a child leaving on holiday to a tropical country (SF931021). Trixie stated she had never had trouble with the parents and she attributed this, in part, to the fact that she lived in the community and knew many of the parents personally, and that her own children attended the school. She described how she kept in touch with the parents' views.

At the beginning of the year . . . I have a parent night. I have all the parents come in and I have a form . . . that has a variety of questions and one of the questions is, "What would you like to see your child learn this year?" . . . Science almost always gets put down there. . . . I see what this group of children, where they're coming from and what they need and then I kind of go from there. (T. N., KS940421, p. 20)
She encouraged parents to come into her classroom at any time. She admitted, however, that she had felt intimidated when she first started teaching at Mountainview (T. N., KS940421).

On the other hand, Marion, an intermediate teacher with only a few years of experience, felt professionally insecure with parents and reflected,

Well, what I find is that no matter what I do someone will criticize; that's sort of a given. So as long as what I'm doing I enjoy and I think is worthwhile, then I just leave all the criticisms out of it. I mean you can't always do that. There's times when I go home and I'm angry, or I'm upset or I think "Well, maybe I'm not doing great for them," but that's when I just sit back and say, "Well what do I believe and what do I think? This is what I think." I remember one parent, [when] we did dissections of tongues, and she thought this was completely inappropriate for the age group, that the kids were too squeamish, she sort of went on and on about that. What was the purpose of it? And afterwards I was wondering why I went to all this trouble and I got flak -- why did I bother? But then during the dissection we had a wonderful time, so that's why I bothered. I'm here for the kids, I'm not here for the parents. (M. Y., JL940421, p. 18)

For the most part, relations between parents and staff were cordial. However, I always sensed that, if teachers weren't careful, disgruntled parents would make their lives miserable. The outspoken parents at Mountainview Community School were a force to be reckoned with and much of the compelling need for change originated in their concerns.

A Strategy for Improvement

School staff designed the TPDP in five stages. The planning team guided this process, drawing on their craft knowledge of staff development and driven by the conviction that teachers are in the best position to design a program to help them meet their objectives. First, the vice-principal wrote the school growth plan for science education. Second, the staff told the university personnel how we could contribute to their endeavor. Third, the school administrators planned the Fall, 1993 workshops in consultation with the university professor, in response to teachers' requests. Fourth, the professor invited the teachers to take part in determining the content of workshops by identifying issues in science teaching,
and fifth, teachers assumed leadership for addressing the issues within the TPDP. In this way, ownership for the improvement initiative lay with the school staff.

Writing the School Growth Plan

When the hiring committee interviewed Steve for the vice-principalship at Mountainview, they hoped that he could help them design a strategy to improve science instruction at the school (S. R., DB940202). They needed help for, as Lily recollected at the end of the year, "Our vision was to improve science education in our school, which was so broad that you could have done practically anything. I mean, we were desperate" (L. N., KS940421, p. 1).

One of Steve's first responsibilities at the school was to write the school growth plan. His strategy to improve science instruction included "extensive and extended staff development and training, peer support, acquisition of materials and equipment [and] use of UBC personnel" (School Growth Plan, p. 11). He envisioned a year-long series of teacher professional development workshops, as he and Nick believed that only such an intensive and extensive effort would be effective (DB940202).

Steve had considerable experience in providing teacher professional development in science and could have run the bi-weekly workshops on his own. However, he remembered the richness of his previous collaboration with Bob and wished to enhance the school's efforts by working with him again. By including university personnel, he also added prestige to the school's effort which would serve to impress parents. When Steve invited Bob to participate, Bob agreed to help in any way he could.

Planning with UBC Personnel

The staff meeting in March, 1993 attended by Bob and me gave teachers an opportunity to tell us how we could help them address their objective. Teachers' requests were general: they requested workshops that were practical, hands-on and directly related to classroom practice. In essence, they described a series of one-shot workshops so the
plan was simple: Bob and I would present a series of bi-weekly workshops with Steve (FN930324).

Bob and I met at UBC, talked by telephone with Steve a number of times, and met with the two administrators at the school in mid-September, 1993 to finalize details of our visits. Nick and Steve confirmed that science had not been a priority at the school previously and said they could not identify any staff members who might see themselves as "science people", other than Steve. They stated that the teachers had used the school's science textbook series, Innovations in Science, very little since its purchase, and not in any sustained way. Nick stated that he believed that many teachers lacked confidence in their ability to teach science so we agreed that, for the Fall, we should focus our efforts on making it easy for the teachers to teach science better (PL930917).

During the year, teachers' comments confirmed Nick and Steve's estimate of staff expertise. Teachers' prior science knowledge varied but only a few told us they felt comfortable and confident about teaching science. The planning team talked about how the composition of this staff was typical of elementary school staffs; Bob described how applicants to the teacher education program at UBC are required to have only one entry level science course, which he viewed as leaving many individuals in our profession as "terribly disadvantaged" (R. C., DB931103, p. 34). He had looked at the distribution of people coming into one UBC elementary teacher education program in the previous year and, out of 180 entrants, found only nine with what he called "a hard science background" (R. C., DB931103, p. 34), with only another four when science-related fields such as anthropology and home economics were included.

The Planning Team Planning Workshops

A need for hands-on activities. Bob, Steve and I responded to the teachers' request for hands-on activities by planning the agenda for the first three workshops. The administrators saw the first workshops as important to the initial success of the TPDP: Teachers must have at least one activity, preferably two or three, that they had carried out
to try with their own children, and teachers should not have to search for supplies, or share, or sign up for their use. Steve promised to take responsibility for gathering materials in advance as long as Bob and I gave him a shopping list (PL930917).

Bob was concerned that we might try to do too much, to try to cover too many quick activities in each workshop and so jeopardize the richness of the teachers' learning. He asked that we try to slow things down, for "Botany at 60 miles an hour is not as good as botany on your feet" (R. C., PL930917, p. 9). Nick acknowledged the temptation to cover a broad range of activities, with "bells and whistles and ready made lesson plans and lots of things happening" (N. F., PL930917, p. 8) and agreed that, without in-depth investigation, activity would be limited to teachers demonstrating science activities to their classes. If we wished to help teachers make lasting changes in their science teaching, we would have to do more than just show teachers a few new activities each week. As Bob said,

We're trying to tackle something very fundamental, and that of course is people's beliefs and attitudes and structures that drive professional practice. Not "do this and here are the instructions how to do it." It's a lot more fundamental than that. (R. C., PL930917, p. 30)

To get at the structures underlying teaching, we had to identify and discuss issues of practice.

A need for teachers to experience teaching science. Steve was not sure that all teachers were teaching science prior to the TPDP and the planning team agreed that teachers would need experience teaching hands-on science in order to identify issues. Steve suggested we focus on helping teachers develop confidence and experience in teaching activity-based science before asking them to identify issues.
Teachers who've been avoiding science or who've been teaching science in a rather rote method or right out of textbooks . . . may not even know what their concerns are yet. But if they take the Cartesian diver into the classroom and if they do the egg-in-the-bottle thing and if they do the candle thing, it's not a unit in science but at least it's some science activities, and from that context they may have concerns that they never would have thought of otherwise. So it seems to me that you'll want to wait until they've had some body of experience before you ask them what their concerns are. It'd be like asking someone "What worries you most about skydiving?" before they've done it. (S. R., DB931006, p. 29).

Bob recalled Steve's earlier comment distinguishing between teachers' anxieties prior to teaching science and issues arising from classroom experience, "the prospect of problems rather than the presentation of problems in practice" (R. C., DB940119, p. 27).

Our plan, then, was first, to engage teachers in doing science activities during workshops; next, to encourage them to try the activities with their children and discuss those classroom experiences in our seminars; and finally, to identify and discuss issues in science teaching based on their experiences.

Fall workshops. In the three workshops before Christmas, Bob and Steve introduced the teachers to three simple science demonstrations, the Cartesian diver, the egg-in-the-bottle, and the candle-in-the-jar. After we demonstrated each activity, we talked about teachers' observations, shared prior knowledge, and constructed understandings of the underlying science concepts through discussion and teacher experimentation. From what we could tell from teachers' comments in workshops and from Steve's observations in classrooms between workshops, most teachers tried at least one activity with their children.

A need to discuss experiences. Bob invited teachers to share and discuss their classroom triumphs, problems, and insights, and teachers often commented on their children's curiosity and wonder during hands-on explorations. Leanne observed that her most challenging children, who often seemed bored with what she taught and sometimes disruptive, had been fully engaged in the Cartesian divers for a half hour (SF931021). Teachers noted their surprise at the rich and extensive vocabulary used by their children.
Hans said he liked what we had done at the first workshop and hoped for more ideas.

Like, for example, the [Cartesian diver] bottle, that we would get more of those kind of ideas . . . and then come back and talk about them. (H. S., SM931020, p. 6)

This we continued to do: We presented an activity to teachers, constructed understandings of the science concepts underlying the activities, and provided a scientific explanation when requested. We talked about how the activities were transformed in the classroom and shared insights and problems of practice. In so doing, Bob directed conversations so that we went well beyond the hasty presentation of two or three quick activities as requested by teachers and that we had feared during preliminary planning talks.

Individual needs. Trixie told Bob and me that she appreciated the way we accommodated the variety of individual teachers' wants and needs, responded to various demands, and allowed teachers to participate in the way they needed to in workshops (T. N., KS940421). Lily commented that we went with the flow and did what the teachers felt they needed, adding that we couldn't have done a better job enabling teachers to try science activities in their classes (L. N., KS940421).

Teachers Planning Workshops

After the third workshop, Bob proposed that it was time for teachers to take a more active role in planning. He wished to move away from "the four of us setting the agenda to this group of people addressing their issues and concerns" (R. C., DB931103 p. 12).

Bob told me prior to the TPDP that he planned to use this strategy; he liked the idea of starting with the question, "What do you folks need to know, and . . . what is it we can concentrate on given the limited amount of time and resources?" He continued,
I would be very happy to try to sort that out with the people at Mountainview School so we gear what we do, in the little time that we have, around agreed upon needs rather than, 'Here's what we know about and here's what we can talk about, and no matter what you want, we are going to do this'. (CR930917, p. 12)

A negotiated course. Bob called this planning style a "negotiated course" (R. C., DB931006, p. 27). He had planned courses this way in the university setting and had found that using teacher-identified issues was a powerful strategy to assure that he met teachers' needs and expectations. This strategy fitted well with the hybrid school project/university course and also with Bob's preference that seminars be conducted as a meeting of professionals, sharing their expertise in a collegial fashion. As he commented to the planning team in October, 1993,

One of the nice things is getting a group of people to look at what has to be done in a day and then decide in what order, what sequence, and what time is going to be allocated, so we play a very small role and they take over the control and ownership for each day. That takes a little time . . . . I've been very very encouraged by what happens when you see leaders emerging and see the leadership revolving around a group, and it's shared, there's not one dominant person . . . . We have to get issues and concerns . . . identified, and then pass them back to the community and say . . . "Here is a commonly held concern. Let's address it." . . . The biggest strength in that room is the people in it. (R. C., DB931006, pp. 9-23)

Bob's words hinted at his ultimate plan, to have the school staff address their issues collegially. As a strategy to get teachers to identify issues from practice, we engaged them in what Bob called a "Q-Sort" activity.

Q-sort. At the first workshop after Christmas break, we asked teachers to work in three small groups to identify issues and concerns related to the improvement of science teaching at Mountainview Community School, to select the ten most important, and to share them with the whole group (CL940105).

A number of issues emerged from that activity which, although common to many schools, were generated by this staff as specific to this school context. After the workshop, I summarized each group's points and sorted them into categories, and found that some issues were mentioned by more than one of the three groups.
Issues identified in the Q-sort were:

- a shortage of time to plan and prepare lessons (3 groups).
- a lack of teacher knowledge about science (3 groups).
- a shortage of equipment (3 groups), funds (2 groups), and teacher resources (1 group).
- a lack of physical space in classrooms for hands-on activities (3 groups).
- a lack of teacher knowledge about assessment and evaluation of activity-based science (3 groups).
- a lack of a school scope-and-sequence for science topics (2 groups).
- a need for more science ideas and themes (1 group).
- teacher uncertainty about how to present ethical or political issues (1 group).
- teacher unfamiliarity with student learning styles (1 group), particularly those of special needs children (1 group).
- teacher unfamiliarity with library resources (1 group).
- a need for better student research skills (1 group).

After the next workshop, Bob stated with satisfaction that, with this list, we were now starting to get at "the hurdles and barriers to science teaching. What are really the issues once you start doing it" (R. C., DB940119, p. 27). We referred to the list when planning workshop agendas, focusing on the issues of greatest concern. We addressed a number of them during the TPDP although not all were resolved by the end of the year. Individual teachers investigated issues of particular interest to them in their own classrooms.

The issue of teacher planning time: A turning point. In the Q-sort activity, all groups identified a shortage of teacher planning time as an important issue, so we allocated time in the next two workshops for teachers to select and plan a science unit. We encouraged them to refer to Innovations in Science as a good source for a variety of grade-appropriate science units.
The outcomes of these workshops confirmed that Bob's negotiated agenda was indeed a powerful strategy. I noticed a rustle of excitement when Steve announced that the next 45 minutes would be "your time" for teachers to use for planning in any way they wished. Teresa and Leanne looked at each other with broad smiles and thumbs up signs (CL940119); as Teresa commented two weeks later, "The planning time we are getting in the science is exactly what Leanne and I need . . . . That's when we're doing most of our planning" (T. F., S940203, p. 12). Teachers appeared busy and content as they worked; I saw intense expressions or happy smiles wherever I looked. Steve, too, observed that teachers were busy; as he put it, teachers were "just working away at their science stuff all over the school". He said, "I just felt buoyant as I left the place last night." Bob responded, "Yeah, you looked it." (R. C., DB940119, p. 1). I asked what had made it such a wonderful day and Steve replied,

Walking around the school and watching what teachers were doing during that hour . . . . The degree of the engagement, sincerity, interest, deep thinking, busy­ness, what was going on, I thought was symptomatic of considerable conviction and interest in what's happening in the course. We had said at our previous meetings . . . . that we felt we were at that turning point where either it's kind of going to go to heck a bit, and people become a little disenchanted and therefore less committed, or the opposite, and I think the good thing happened. (S. R., DB940119, p. 5)

This enthusiasm validated our decision to move more responsibility for planning workshop content to the teachers. At the end of the year, teachers told me at a roundtable discussion of the TPDP that they liked the approach of teachers setting the agenda as well as having the flexibility and freedom to choose the projects on which they worked so that their coursework for credit was directly related to their teaching (RT940504). When I asked them what we could have done wrong to make the whole project bomb, they laughed and Leanne spoke. "Bringing an agenda to us and saying, 'This is what we're doing" (L. M., RT940504, p. 12). Jacqueline added spiritedly, "That's NOT the way we want it!" (J. K., RT940504, p. 12).
Teachers Assuming a Leadership Role

In our debriefing session after the Q-sort, Nick reflected on the activity, saying,

The answers, the way to address these concerns, was in the hands of the people that were sitting in the room. It seems to me that you could probably interest individuals or small groups in taking over one of those concerns and then coming back to the rest of the group with a proposal or suggestion on how it might be dealt with. (N. F., DB940105, p. 1)

We didn't need to take that step, however, for a surprising and gratifying event took place. Looking closely at this event, at how teachers resolved the issue of the shortage of science materials, illustrates how leadership for addressing the school's science objective shifted from "the experts", that is, university personnel and administrators, to the practitioners, a development welcomed by the planning team.

Steve foresaw a need for equipment and supplies and, prior to the TPDP, purchased everything but consumables on the general list of materials suggested in Innovations (S. R., DB931103). However, he did not organize them for easy access and teachers were unaware of what was available (CL940119). In the second workshop after Christmas break, Marjolaine, for whom materials were a particular problem, told the group she had been thinking of ways to address the issue. She had begun to take an inventory and asked teachers to set out materials hidden away in their rooms in a central area. Teachers were supportive of her plan but Jill spoke up, frankly acknowledging her reluctance to participate, since she hated to give up the items she used only to see them disappear into other classrooms with no way to track them. This indicated a need for a sign-out system. The workshop ended without details being resolved beyond an agreement that this inventory would continue (CL940119).

When Bob and I returned to the school in February, 1994 to act as two of many judges of the school's science fair, we discovered that Marion had joined Marjolaine in leading the effort. She met with Steve, Bob and me, telling us that she and the Marjolaine had gathered, organized and labeled materials and equipment from all over the school, entered
them into a computerized data base, and stored them centrally. She had a suggestion for our next workshop.

What we'd like to do now is find out what the other teachers need so we can start ordering it. So what we thought we'd do at the next science session is give them some time to look at their [current] unit or the next unit, whatever is appropriate, and make a list of all the equipment they are going to need . . . . I can print the data base out so they'll have a copy to tell them what's there now, and then go over some kind of sign-out system so we know where it is. (M. Y., CH940211, p. 3)

Bob responded with enthusiasm that it was a wonderful idea; "I can't think of anything better to do!" (R. C., CH940211, p. 3). And so it happened.

An idea becomes a plan. By mid-March, 1994, teachers decided to use a sign-out system to keep track of materials and made extensive lists of needed consumable materials and science equipment. Marjolaine and Marion offered to take the process to completion by ordering equipment from catalogues and shopping for consumables during Spring break; Steve and Nick assured them that they should buy whatever they thought necessary. By the end of the year, consumables had been purchased locally and large orders from science supply companies had begun to arrive. The storage room was renovated and renamed the science storage room, materials were neatly stored, and a sign-out system was in place and used on a regular basis.

Teachers' appreciation. Teachers were grateful to their colleagues who led the effort; as Leanne recalled in April, 1994 the daunting task of gathering science materials and equipment had contributed to her reluctance to teach hands-on science; she called the gathering of materials an "obstacle" (L. M., D940407, p. 13). Jacqueline's comments echoed her sentiments:

Putting the materials together, that was one big step, [giving me] motivation to keep on going and to do more, because trying to find everything -- forget it! My attitude was, forget it, I don't have time to search for the stuff. (J. K., D940407, p. 7)

Kelly had taught science prior to the TPDP but felt hampered in her efforts to do hands-on activities with her children.
This school's never really had the equipment to do it, and when you don't have the equipment you just kind of fall back to "Open the text book" and "We're going to learn this today". It just became very uninteresting to me . . . . There were so many things that I wanted to do that involved equipment that I just couldn't do. (K. D., LJ940421, p. 4)

For her, knowing that requested materials were arriving at the school towards the end of the year was very important.

With all the new science equipment . . . I've already decided on what my science program is going to be for a good part of next year . . . which is really exciting because I'm not walking into next year thinking, "What am I going to do?". I know that I've got all that equipment, I know exactly what I'm going to do with it, how I'm going to organize it. (K. D., LJ940421, p. 21)

Ownership residing in the school. Bob referred to the two workshops after Christmas break as a "watershed", remarking, "It makes great sense for the leadership to be put in the school" (R. C., DB940119, p. 29). Steve said something similar earlier in the conversation, that "The responsibility has been taken on now by our school and the staff" (S. R., DB940119, p. 2).

A school project or a university course? Bob's original intention was that the TPDP be a school project and that leadership come from the school; he would make course credit available as an adjunct to the school improvement project. He sensed in the Fall workshops, however, that staff members looked to him for leadership; they thought of the workshops as "the course" for which 15 teachers received credit.

For the first workshop, Steve arranged the teachers' tables in a large horseshoe with two chairs and a small table facing the staff, clearly indicating that Bob and I would lead the workshop; the administrators sat at tables with teachers. This arrangement and the roles it implied worried Bob, and at the planning team's debriefing meeting he broached the subject of what roles each of us should play. Steve's words show that he viewed himself in the role of helping Bob, a reversal of our original intended roles. Bob, however, insisted that we were a team.
Bob: What role do you want to play in this enterprise? How do you guys get involved?

Steve: Just the way we have today, I guess . . . . I'm willing to have any level of participation, the way we [the administrators] did this today, which was basically sit at the back, ask questions occasionally and participate the way the other people did, or help you guys out when necessary. But on the other hand, I don't mind coming right up to the front and taking over part of the meeting . . . . I'm willing to go from no role to lots.

Bob: It would be nice if the room didn't have a front, that we had a circle, so that it's not identifiable where anybody is, so if anybody wants to take the stage . . . . You played such a vital role [in the DESSIP] . . . . That was great. (DB931006, pp. 34-36).

Steve's next comments illuminate his confusion arising out of the metamorphosis of the series of workshops into a university course.

In this one I hadn't envisioned being quite as active, simply because when the credit course idea came up, my perception of my role changed. And now I'm beginning to see that that wasn't necessary, that it can unchange. (DB931006, p. 36)

With that understanding, the planning team returned to a more collaborative approach in our planning and Steve took a more active role in presenting workshops, as well as providing leadership when practical matters related to the school came up. Even so, it wasn't until after Christmas break that the teachers embraced the notion that the TPDP was their program. This sense of ownership contributed to the success of the TPDP in meeting the school's objective in an important way, for it encouraged teachers to identify their particular issues and find ways to address their own problems. Steve summarized,

When we talked about how do we meld this thing called a university credit course with this thing called professional development project and get the best out of both . . . . We wanted the feeling of expert knowledge and resourcefulness to reside in the group itself and not in anyone who was viewed as instructor or a facilitator or a professor or an experienced expert. (DB940316, p. 7)

Bob called this "empowerment" (DB940316, p. 7). Nick commented on the strength inherent in this approach to designing the TPDP when he said,
There was a point in this exercise when it really didn't matter if a session failed . . . because they [the teachers] would have viewed the failure as their failure not your failure. It would have been our failure; collectively we would have failed and yet when you fail collectively, is isn't really a failure at all, it's a set-back. Easy to overcome . . . . The shift was made from it being your program, to being their program. (N. F., DB940316, p. 10)
A Comprehensive Professional Development Program

The TPDP incorporated a variety of activities in response to teachers' requests, lending the endeavor strength and flexibility and allowing the planning team to meet the varied needs of individual teachers. In so doing, this comprehensive professional development program blended aspects of Sparks and Loucks-Horsley's (1990) five models of staff development.

First, the TPDP originated in a school improvement project which emphasized staff development as the critical strategy for addressing the school objective for science. In this development/improvement process, staff members worked as a group to address their identified problem of science instruction as in need of improvement. They wished to seek their objective by acquiring knowledge and developing new skills, and designed the program to meet their needs.

Second, teachers receiving credit for their participation were required by Bob to set a personal goal and to design a project that would help them improve their teaching, for he believed that each individual could best decide how to enhance personal professional growth. Given free rein to set goals and seek them through individually guided professional development, teachers designed projects that varied considerably. For example, Frances, the teacher-librarian, recognized a need for better science resources in the library and better support for classroom teachers. She added to the science collection, worked with classroom teachers to support their classroom science units, and arranged for a number of authors of science-related books to visit the school and speak to staff and students (EJ940421). Marjolaine, an intermediate Programme cadre de francais teacher,
wished to teach science on a regular basis and developed a number of science units which she presented to her francophone colleagues at a provincial conference (KL940407).

Other teachers' projects were an inquiry into their own practice. For example, Bonnie, a learning assistance teacher, wished to develop a better understanding of her special needs students' learning in science. She teamed with Kelly, a classroom teacher, to teach a science unit. This gave Bonnie insights into both her students and into the challenges faced by their classroom teacher (SA940421).

Two school professional development days were spent training teachers in the use of instructional resources: the BC Ministry of Environment, Lands and Parks's "Project WILD" and BC Hydro's "Power Smart" program. These were stand-alone sessions in the tradition of "one-shot" workshops in which the presenters select activities to familiarize teachers with the programs, enhancing awareness and knowledge and developing skills. In a less formal way, the planning team modeled science teaching at each workshop and engaged teachers in the activities with the intention that teachers implement them in their classrooms.

Finally, a number of teachers requested that members of the planning team visit their classrooms to observe their science lessons. Teachers looked to us for encouragement and requested feedback, loosely following an observation/assessment model.

Members of the planning team drew on their combined and varied experience in teacher professional development to meet teachers' requests as they unfolded during the TPDP, rather than following a single model or a fixed agenda. In all cases, however, the TPDP emphasized an approach to learning often called "learning-by-doing". This approach contributed significantly to TPDP outcomes: changes in classroom instruction, in teacher attitudes towards science and teaching science, in staff relationships, and in parents' perceptions of science education at the school. The learning-by-doing approach was evident in workshops, when teachers learned about science through first-hand, direct engagement with science materials, and in classrooms, when teachers learned about
teaching science by teaching science. Reflective discussion accompanied these activities: Discussions occurred with the entire group of participants at workshops, between individual or small groups of teachers and members of the planning team outside of workshops, and between teachers as they planned their science programs collaboratively. This approach went beyond what the teachers envisioned prior to the TPDP, that is, a series of workshops in which "science experts" demonstrated hands-on activities.

More Than Science Demonstrations

In March, 1993 teachers were explicit about how they thought Bob and I could help them reach their school growth plan objective for science. They wanted us to show them some simple activities at each workshop that they could do with their children, and to talk about science resources and materials. They did not request information on the history of science and philosophy of science education, nor did they wish to learn by reading and discussing journal articles. The workshops were to emphasize demonstrations of hands-on activities having practical application in their classrooms.

In essence, the teachers requested a series of one-shot workshops presented by acknowledged experts, a common approach to science professional development. They expected Bob and me to demonstrate activities and to provide background information and explanations of the science involved. Teachers expected to re-enact these demonstrations with their children and transmit scientific explanations to them. The transmissive approach to teaching is common in elementary classrooms where the teacher's role is that of "the knower" who teaches through demonstration and explanation. Teacher science resource books usually use this approach, as do popular television programs for children.

An alternate pedagogy. What teachers did not anticipate was that Bob had a different pedagogy in mind, based on exploration of materials, sense-making through reflection and
discussion, and concept construction based on fitting those experiences into a previously constructed matrix of knowledge.

Bob's stated belief was that learners, whether children or teachers, can best direct their own learning by pursuing their own questions and seeking their own answers. He observed a Grade 3/4 class working with magnets in a learning-by-doing fashion and said with great satisfaction, "That magnet afternoon is my ideal of a science experience: Don't try to put any structure on the experience" (R. C, KS940421, p. 3). He said that learning-by-doing takes time and that teachers often rush the experience with their children.

When I have done things with weighing in kindergarten, some kids get absolutely obsessed. They weigh anything and everything, they go on and on and on to the point of my feeling, "Gosh, they must have exhausted it!" But yet they haven't. I think that really getting to know something takes an enormous amount of time, of doing, redoing, and redoing. I think that's the way kids learn when they are very young. I think we in schools have said, "Aah, we do it for half an hour and you will have got it" . . . . Natural learning is a lot of revisiting, a lot of revisiting. The big issue comes up, when is it learning and when is it just play? And to me that is a really murky area. What we define as play is very serious learning. (R. C, D940407, p. 5)

Bob talked about how he thought that children are more imaginative than adults and that if they took an unexpected direction in their investigations, then the teacher should go with that (SM931020). He discussed this student-led approach to teaching with Jacqueline, contrasting it with the way teachers are accustomed to teach.

I think this logical, deductive, rational way of thinking that is scientific is only one way that we operate as human beings. There is a whole world of fantasy and imagination and creation, and I think that kids flip-flop continually between them, and to want them to go that linear route is to deny them their childhood. I feel comfortable starting something with fungi, looking at mushrooms, and ending talking about toadstools and toads and fairies and reading fairy tales. That's fine, the science is there, the experience is there. Why would I want to say, "This is science today; we can't do that"? (R. C, D940407, p. 4)

Alternate roles for teachers. Adopting a learning-by-doing approach implies changes in the teacher's role, for teachers must observe children carefully and determine what the children are doing, and why. Teachers need to look for meaning in children's explorations
and see significance in children's suggestions. In a workshop discussion, when teachers raised the issue of the changes in their role, Bob said it is

a really critical area in terms of teaching science in the classroom . . . . Seeing meaning in hands-on activity, and having seen meaning, what do you then do to help these young children progress? (R. C., SM931020, p. 5)

Steve suggested to the group that they think of ways to move the children just one small step in their understandings, rather than trying to teach them the right answer, for there are many levels of explanation for any activity, from a kindergarten level to a university level.

Bob suggested to the group that they reconsider their usual role of an expert demonstrating activities and answering children' questions, and that instead they try facilitating children's explorations by attending to

[the] meaning that children make with materials and the understandings that they bring, and the opportunity to explore, until they come to a point where they can no longer make further sense, rather than truncating that opportunity for exploration by saying, "Here is the single and appropriate scientific way to look at it". (R. C., SM931020, p. 7)

**Learning Science by Doing Science**

Bob's stated belief was that the best way for teachers to learn science was by doing science. Teachers themselves must become engaged with the science materials and explore their own understandings of what science is and what roles they might take as science teachers, in order to develop an understanding of fruitful ways to work with children. He wished to start by capturing teachers' own interest in science.

**Workshop activities.** Bob and Steve typically demonstrated the science activities, with Bob leading the discussion of science concepts underlying the activities. I most often introduced topics for consideration by the group, such as when I familiarized teachers with the Innovations in Science materials. We three roamed around the room talking with teachers as they worked with materials; Nick sat with teachers and took part in the activities.
Each workshop included one or more hands-on activities. Steve, Bob, and I set up the room ahead of time with enough materials that teachers could work individually or in small groups. On a few occasions we set up stations among which teachers could circulate as they wished. We invited teachers to explore materials, observe, pursue their own problems, explain and generate theories. After teachers worked an hour or so in small groups, the whole group discussed the experience and unpacked the science concepts underlying the activity, sharing insights and explanations as we struggled to make sense of the activity. Bob believed this was the best way to help the staff learn science concepts and develop a new pedagogy.

Science can be fun: Changes in teachers' attitudes. Bob selected workshop activities which often included an element of mystery or surprise and engaged teachers intellectually. These activities were usually new to teachers and captured their attention. The notion that science is fun was new to some teachers (J. K., D940407; B. F., SA940421), and the teachers' enjoyment was evident in the first workshop and at every workshop thereafter. They were intrigued by the mysterious rise in water level with the candle-in-the-jar, startled and delighted by the loud plop of the boiled egg sliding into the milk bottle, and surprised by their unclear understanding of magnetism. They shared their feelings of delight and surprise with their colleagues.

Following the first workshop, the principal commented on the teachers' exuberance: They seemed almost relieved to discover that these workshops might be fun. Teachers called out, "Look at mine! Look at mine!" (DB931007). Animated conversations and peals of laughter often accompanied group activities (CL940105, OB940316).

Nick noticed at the third workshop that teachers became so involved in working with magnets that they did not want to stop to debrief the activity. Afterwards, he commented on the intensity of the teachers' involvement with the hands-on activities.
I'm really pleased with what's going on and with what we're doing. And overjoyed . . . . I'm seeing some really, really thoughtful questioning, I'm seeing some real enthusiasm. I mean David and Kay were really, really into it. And Evelyn came in a little late and sat down and immediately got right into the activity. (N. F., DB931103, p. 23)

Changes in teachers' confidence. Teachers who, prior to the TPDP disliked science or thought they just couldn't "do science", developed confidence from their first-hand engagement with materials. One of our last workshops included an APASE (Association for the Promotion and Advancement of Science Education) science module, "Engineering for Children: Structures". At the end of a busy and enjoyable workshop, a teacher commented to me, "I didn't think I could do anything -- I'm proud!" Another commented to me that she was surprised and pleased with herself; she had never done anything like this before but had really got into building a 30 cm span bridge (FN940420).

A model for teachers. Jacqueline said that our approach modeled what we encouraged teachers to try with their children (RT940504), a pedagogy that, while new to most teachers, could be implemented in their classrooms. By emulating our approach to science teaching, teachers developed confidence.

Learning to Teach Science by Teaching Science

Bob's stated belief was that the best way for teachers to learn to teach science is by teaching science. Many teachers were willing to try these simple activities with their children and it was easy for them to do so as we provided them with all necessary materials to take back to their classrooms. Teachers appreciated this feature; as Teresa said, "I've been at workshops where you do things, but you never come back and do them again. Either you don't try them, or you don't have the materials" (T. F., RT940504, p. 16). Jacqueline continued, "It's like coming back from a carpentry course and not having a hammer [laughter]" (J. K., RT940504, p. 16) and Frances added, "And you don't have an instructor to initially help you out" (F. C, RT940504, p. 16).

Teaching science can be fun too: Changes in teachers' attitudes. When teachers spoke about their classroom science teaching during the TPDP, they frequently mentioned how
much fun they were having with their children as their excitement with the activities transferred to their teaching. On one occasion, Trixie arrived early at a workshop eager to tell me that she and Nancy had tried the egg-in-the-bottle experiment with a class (DB931103). She was exploding with excitement and laughter as she told me the tale. She later told Bob it was the highlight of her year.

Well you know, for me the biggest thing was when Nancy was teaching in my class at the beginning of the year, and we did the egg-in-the-bottle experiment together. . . . She and I were both standing up there and doing this experiment -- we were really having fun. And then there came a point where neither one of us knew what to say or what to do. And it felt so great not to be the only one who didn't really know what to do, or what to say. We both looked at each other and went, "We'd better get the book!" We didn't have a clue . . . . Yeah, I absolutely loved that experiment. It was so neat because the kids were so fascinated and so enthralled with, you know, watching us and discussing it. I have to say, yeah, that was the highlight, when the egg blew up in my face. [laughter] (T. N., KS940421, p. 21 & p. 26)

Workshop discussions. Bob believed in the importance of discussing classroom experiences at each workshop. He and I discussed the difference between simply providing the teachers with quick ideas, and working with them over time to reflect on and discuss classroom experiences. Bob called this

a critical issue . . . . Are we providing quick tricks which people can incorporate into their repertoire? But they are building it into a matrix of ways of working that already exist, and nothing changes necessarily in the way they view teaching and learning and children, and the adult role within that. (CR930917, p. 75)

Bob spoke of a bridge between the teachers' developing understandings of the nature of scientific enquiry, and their science teaching. He told Nick and Steve prior to the first workshop,
What [do] we really see as professional development in science for the individual? . . . Is it coming to a richer understanding about the nature of scientific inquiry and your knowledge of science on one side, and on the other side: Is it a richer understanding about where children come from in terms of the body of knowledge that they bring from everyday life? . . . It's a very ambitious idea -- I mean we'd be very happy if a little bit of that happened -- not the limitation of the people we work with, but our limitation to create an environment in which that happens. (R. C., PL930917, pp. 6-7)

A need to discuss problems emerging from classroom experience. Our strategy of learning-by-doing and then talking about the experiences worked; teachers tried activities in their classrooms and talked about both successes and problems. Looking closely at one such problem provides a good example of how teachers examined their beliefs with reference to their classroom experiences.

At the second workshop, a teacher who had tried the first workshop's activity with her class raised the problem of teacher knowledge. Tilly described how she felt when she tried the Cartesian diver with her primary class; her comment reveals the effectiveness of getting the teachers to try an experiment as a step towards identifying their concerns.

I found it really worthwhile, but as a person with no prior real background knowledge in science, I was very frustrated because I couldn't direct the children. After they had explored and played with the bottle and everything else I felt, "Well this is great, what do I do now?" Because I didn't know how to explain to them . . . exactly what was really occurring . . . I'm frustrated with not knowing. (T. D., SM931020, p. 5).

Once Tilly shared her feelings of frustration, other teachers joined in and she discovered that she was not alone in feeling this way. Teachers were frank in saying they felt insecure about what they described as their limited scientific knowledge. Evelyn, a kindergarten teacher proposed, "If we could look back on an experiment afterwards and you [Bob] explain it in some way so that we could go back to our class and explain the principles . . . ." (E. I., CL931020, p. 1). This issue was clearly important to teachers; Bob proposed that the group spend time talking about the nature of knowledge and how it develops.
How teachers saw the issue of teacher knowledge. Evelyn made a comment indicating that, for her, knowledge was power. "I want to know the answer for myself, not to tell the kids. We want to be empowered to set things up well enough that we don't have to go to a book" (E. I., CL931020, p. 1). Similarly, later in the year, Teresa and Leanne talked about how they felt vulnerable if they didn't know the scientific explanation. "In Intermediate, you have to know what you're talking about. In primary you can fake it, you generally know more than the kids do, but at this level . . . . " (T. F., S940203, p. 13). They described a "major fear of the unknown" in which "you are gripped with apprehension -- you don't know what it is . . . . " (L. M., S940203, p. 16). These two teachers also spoke about needing to be knowledgeable so they could provide their children with an appropriate science program in preparation for High School. For other teachers, the issue was one of not knowing what to teach next, as they saw their teaching role as that of an expert responsible for directing student activity and providing their children with explanations, and they thought they couldn't do that (FN940106).

At the end of this rich discussion, teachers insisted that still they wanted a scientific explanation for the candle-in-the-jar, the activity they had just spent an hour exploring. Bob provided the teachers with an explanation despite his earlier caution that

the explanation that we give is going to be limited. The concern that we would have is that that would become the only thing that happens, because that would seem to me to be very limiting. (R. C., SM931020, p. 7)

Teachers were quiet as they listened intently; Kelly's face lit up with a satisfied smile as she said, "I was right!" (K. D., CL931020, p. 2). Months later, she told Bob that if he had not provided the answer she would have been really frustrated. Even though she realized that Bob wished teachers to develop their own understandings through engagement with materials, she viewed him as the source of the right answer and of her knowledge. She commented,
There were times when you would do an experiment but you didn't want to give us the answer. That drove me crazy because I feel like there's always got to be something learned; I just felt like if I didn't find the answer or see how it works that I hadn't learned what I was supposed to learn . . . . You reluctantly finally gave in, in all situations, and sort of gave the answer and we sort of came up with our reasonable answer . . . . If you hadn't given the answer I would have been really frustrated" (K. D., LJ940421, p. 12).

Late in the year, the teacher who had initiated the discussion concerning teacher knowledge referred to this issue as her need to know The Why. Tilly talked about how her approach to teaching had changed during the year. She told Bob and me,

The Why! I found a great book that tells me Why. [laughs] . . . [Janice VanCleave] tells you what to do and why things are happening . . . . Even though I'm not telling kids at the beginning of a science lesson that that's The Why, I will mention in the week or whatever, just because some kids do, as well as myself, need to know. (T. D., SA940421, p. 1)

Bob responded, "But I think in the end the only way that can be answered is for the individual to answer it" (R. C., SA940421, p. 2), and Tilly agreed.

Changes in teachers' roles. When teachers tried the learning-by-doing approach, their teaching roles changed. Hans commented ruefully that, although he understood the experiment he had done with his class and had wanted to explain what was happening to his children, they were so involved in the activity that he couldn't (H. S., CL931020). Jill commented that previously she would tell the children, "Now we do this" and direct them to observe the result of the experiment; now she observed that her children were so intent on the activity that not one asked her for the explanation, and most children went home saying, "I want to do this at home." She valued this engagement with the materials and offered an insight: while she wanted to know the answer for herself, some of her children might not yet be at that point (J. N., CL931020).

Steve told Bob and me about how Kay developed an insight into children's learning through a classroom experience, an insight that had implications for her role as a teacher. She took a variety of magnet materials into the kindergarten with the intention of giving the children a bit of time to play around with them; she used David Hawkins' (1965) term,
"messing about" for such free exploration. She planned next to conduct some lessons that
she would prepare ahead of time. Steve told us part of his conversation with her.

She feels the need to eventually work towards some more focused activities than
sort of messing about . . . . But what she realized in the messing about was that in
what she thought kids were going to be interested in . . . and what kids were
interested in regarding magnets, there was very little overlap . . . . She saw them
messing about, figured out what they were interested in and was thinking about
what the focused activities might be based on what they're interested in, not what
she's interested in . . . . I stopped [her] at that point and I said, "Well, you know . . .
what you've just realized really indicates that you're working at a fairly, I think I
said, sophisticated level of planning science instruction, because it's student
centered . . . . You're listening to the children, you're finding out what they know,
you're finding out what they want to know and what they want to work with, and
then you're thinking of how you might honor that in the future." (S. R.,
DB940119, p. 27)

Classroom Support for Teachers' Learning

Underlying the structure of the TPDP was a belief that teachers investigating changes
in classroom practice should have regular classroom support available to help them get
started. We sensed the enormous potential of a program that explored the fragile link
between the "You should try this" world of the workshop and the "I can do this"
classroom world of the teacher. As Bob said,

There's this inter-linkage, this constant hopping back and forth, from classroom
experience, to workshop experience, to previous workshops, to future workshops . . .
which knit the entire experience together. (R. C., DB940316, p. 14)

When Bob and I visited the school in March, 1993 prior to the TPDP, we informed
teachers that we were willing to help them address their school objective of improving
science in any way they wished. At that meeting, teachers did not specifically request
classroom support as a feature of the coming year. I am not sure when the idea that Bob
and I would be available to work with teachers in classrooms crept into our plans; I
suspect it was a feature that Bob and Steve discussed in a roundabout way at some time,
in the sense of, "Wouldn't it be nice if . . . .". When Bob and I visited the school in
September, 1993, the administrators hastened to let us know that we were welcome to become regular visitors to the school during the school day (PL930917).

Bob and I went to the school only to present the workshop on our first visit, to get a sense of how the course would go, but for our second visit, Steve devised a sign-up system and posted a schedule with room for four teachers to write their names requesting visits from each of us on Thursday (SF931021), a system that persisted throughout the year. There was no pressure or expectation that all teachers take advantage of this opportunity, nor was there any distinction between credit and non-credit participants. We left it to the teachers to tell us what they would like us to do (PL930917).

Spending a day at the school after the workshop allowed Bob and me to build warm personal relationships with teachers on Thursdays in a way that would have been difficult if we knew them only through workshops. I sensed that Bob and I were welcomed by teachers as colleagues who had the time to stop and chat about teaching, unlike their busy fellow teachers who always seemed to be rushing about the school on errands. This helped alleviate teacher isolation so common in schools; I had felt it myself for many of my years in the classroom. We also had enormous flexibility in how we supported teachers as they tried new approaches to science teaching.

Bob and I visited teachers together or singly. Some teachers asked us to demonstrate a science lesson (October 21, 1993; November 4, 1993; March 17, 1994), others to observe their lessons (November 4, 1993; January 6, 1994; January 20, 1994; February 3, 1994; March 3, 1994). I accompanied a class on a field trip (January 20, 1994), and Bob met individually with two classes of intermediate students to discuss their science fair plans (February 3, 1994). Lily had an open door policy and invited us to stop in any time, whether for science or not, or for a cup of tea. Some teachers just wanted to talk with us outside of class time; this we did by making use of teacher-on-call funds or outside of school hours by meeting for breakfast or dinner or going for a walk at lunch time.
Support Roles for UBC Personnel

The professor, Bob enjoyed his classroom visits. Towards the end of the TPDP, I articulated an observation that I made throughout the year, and even prior to the TPDP when Bob and I did a small research project with Grade 7 children in Vancouver.

Bob walks differently when he enters a school to do hands-on work, or into a classroom to work with kids. He really comes alive. His step is springy and sprightly, he smiles, does set-up with great energy. That's what he really likes—working with kids! (C. B., OB940316, p. 1)

Before the beginning of the TPDP, I asked Bob how he preferred to work in classrooms. He told me of his experience at another school:

[When] I worked with a teacher at Gibraltar School [a pseudonym], I let her control the whole management of the class. I said, "If you are not content with the way the class is behaving, then you take over." When I put a list of things on the board, she took over and got the children to repeat them; when we were distributing materials, I let her organize the distribution . . . . What we were doing was something that wouldn't have happened in that classroom otherwise, because she didn't know how to do the science in that context. But she knew how to do all the administrative [details]. And at the end we had an interesting talk about what they had found out . . . . [This approach] begins to leave the initiative [to the insider] and also casts the insider as someone who acknowledges or recognizes a way of working that they want to maintain. There is no element of judgment on the visitor's part. (CH930916, p. 7)

I observed Bob demonstrating an activity while the teacher watched. Somehow he conveyed the impression that he was a guest within the teacher's lesson, rather than an expert taking over the lesson to show off his prowess to the teacher. He said to me earlier,

One does not want to come in as the expert. You want to come in as a facilitator. I think so much of pro-d is, "Bring in Mr. Fixit and give us the 45 rules that we can follow, and everything will be just fine". (R. C., CR930917, p. 6).

Instead, I saw Bob play the role of a knowledgeable colleague working alongside teachers to facilitate change. This way of working with teachers acknowledged their expertise, involved them in the lesson as they helped shape the experience for their children, and centered attention on the particular activity rather than on him. It communicated his belief
that "Everybody has a voice of experience. We just happen to be a voice that's from outside. It is no stronger or better" (CH930916, p. 12).

While Bob was not hesitant to demonstrate a lesson to a class if asked, he seemed to prefer watching teachers as they taught and chatting with small groups of children as they worked with hands-on materials (OB931104).

Teachers spoke about benefits of Bob's classroom visits. For instance, Leanne commented, after watching Bob introduce the Water Box to her class, that she really enjoyed observing her children while someone else taught (OB940316). David commented, "I explained to the kids that I was learning from Bob; you never stop learning." (D. T., RT940504, p. 5). Lily shared with us a journal entry of one of her children. "I like it when the visitor comes in. He is fun and knows lots of things" (L. N., KS940421, p. 4). When Bob spent a Thursday morning meeting individually with Grade 6/7 children to discuss their ideas for science fair projects, the experience was cherished by both Bob and the children. Teresa told me,"[A child] came up to me and said, 'Is everybody going to be able to meet with that man in the library? Because I really want to.' She's worried they won't get to the W's" (T. F., S940203, p. 18). At the end of the year, Frances, the teacher librarian, recalled that morning.

I was watching and as kids came in, Bob stood up, shook their hands, and kids stood about 10 feet tall. They sat down and they were very serious about it, the discussion. It was neat; the kids felt special. This person was taking an interest in them. (F. C., RT940504, p. 3)

Myself. When I visited classrooms in the Fall, I assumed the role of an expert showing off to novices first, because that was what I thought teachers asked me to do, and second, because demonstration lessons were all that I believed I had to offer teachers. A teacher's invitation to me in Fall was typically something such as, "I'd like you to come to my classroom; you can do anything you like. I really don't know much about teaching science." I might then ask what she was doing in science, and the teacher would reply that
she would like to try something on ____. I would propose, "Perhaps I can teach a lesson on ____," and I would.

My previous experience working with teachers in schools had been inviting teachers to visit my classroom to observe my science lessons; on a few occasions I visited other teachers' classrooms to teach demonstration lessons with their children. Our shared expectation, then and again at Mountainview, was that my teaching would provide the teacher with a model of exemplary science instruction. A number of assumptions were embedded in that expectation: We believed I could teach an exemplary lesson; we believed the teacher could learn from observing me; and we expected the experience could be transferred with success the teacher's own teaching practice. I think now that all three assumptions are questionable.

I discovered at Mountainview that modeling a lesson with an unfamiliar group of children in an unfamiliar classroom was very different from teaching my own familiar class in the homey surroundings of my own classroom. I felt these demonstration lessons were fraught with problems in my teaching, in my modeling, and in teachers' passive observation, and I grew increasingly uncomfortable with taking over a class to demonstrate a science lesson. After the Fall, I stopped teaching "model lessons".

A teacher's view. At the end of the TPDP, Lily, a teacher whom I came to like very much and who invited me into her classroom throughout the year, recalled my first classroom visit with these words: "When Clare came the first time, she took over." I felt chagrined at her comment for, by the end of the TPDP, I believed that was exactly what I should not do as a visitor. However, she continued, "It was great! . . . It's great for the modeling. We never get a chance to watch someone else" (L. N., RT940504, p. 5).

A role of judge. I was no happier with another role teachers asked me to play, that of passing judgment on their teaching. Before my classroom visits, teachers frequently asked me to comment on their teaching. For instance, Tilly invited me to visit her class during a math lesson at the beginning of the TPDP, just to walk around and get to know the
children. After she welcomed me, she commented that, if there were anything that I could see during my visit that she could change or do better, I was, please, to feel free to tell her about that (SF931021). I recorded my thoughts after this visit.

I think it would be entirely patronizing of me to pat her on the arm and say, "You know, Tilly, you're a wonderful teacher." I don't feel that is appropriate. The highest praise that I would have for her from today is that I really enjoyed the time that I spent in the classroom with her. (SF931021, p. 1)

Teachers sometimes apologized after I observed a lesson, or even in advance, for what they described as their children's lack of science knowledge or poor behavior (and which I viewed as excited and enthusiastic involvement).

In my notes, I commented on the openness of teachers when they invited me to visit them while they taught (SF931021). However, at the end of the TPDP, teachers confirmed my sense that, despite their welcome, my visits were stressful for them. Teachers talked about this pressure and about how they became more comfortable over time with my visits. As Teresa said,

The first time I wasn't sure in what capacity you were coming in. I hadn't taught this level in quite a while, I had no idea what hands-on science meant . . . . I was scared! . . . After a time, it didn't bother me when you were there . . . . Now I would sign up whenever there was a spot; I appreciated your ideas. (T. F., RT940504, p. 4)

Jacqueline agreed with her.

That's the way I felt, too. When I saw the sign-up sheet the first time I thought, "No, no, no. Can't do that, I'm afraid that I'll flunk it, or it won't work, or I'll be evaluated!" My mind was total refusal, I didn't want anyone in my class, I was taming the subject myself. When I was ready, then yes, but it took time. (J. K., RT940504, p. 4)

As I got to know teachers better, I became increasingly appreciative of their considerable teaching skill and experience and I became increasingly uncomfortable with the role I felt I was pressed into playing, that of visiting expert and judge of quality.

My changing role. As the year went on, my role changed, for two reasons. First, teacher's expectations changed; they viewed Bob and me less as experts coming to show
them "the right way" to teach science and more as colleagues interested in investigating teaching practices together. Second, I learned that there were other, perhaps better, ways to interact with teachers for, as the year progressed, I observed Bob at work and spent many hours discussing our experiences with him.

I felt that a role I could play when I visited classrooms was to comment positively on the children's enthusiasm and involvement (OB931104, SF931021, OB940106). However, I continued to feel uncomfortable with the fleeting looks of relief that flitted over teachers' faces when I made encouraging comments; it struck me how difficult it must have been for them to expose their practice to an "expert".

Gradually my role shifted from advisor and judge to interviewer and facilitator and non-judgmental colleague, closer to the role I observed played by Bob. In February, 1994 I met on a Thursday morning with Teresa and Leanne. After they talked about what they had been doing in science and the changes in their practice they had noted, I asked, "What would you like to do now; what would be the best use of time for you?" (C. B., S940203, p. 16). They decided to spend the time preparing for the upcoming science fair which they did, with only a few comments from me.

I began to look forward to chatting with teachers, brainstorming ideas for science lessons and acting as a sounding board as they analyzed their own practice; I found that I could lend an understanding ear, for I was only recently out of the classroom myself.

**Responding to journals.** Another role I liked was responding to journals that Lily and Elizabeth chose to keep as part of their course assignment and which they asked me to read. I relished reading these logs each Wednesday evening in the hotel, for they gave me a window into classrooms that otherwise would have been curtained. I wrote extensive comments in the margins, sharing my thoughts on their remarks and often referring to similar experiences that I had in classroom teaching. Steve told me how one teacher told him how much she enjoyed this exchange of ideas.
Elizabeth was absolutely thrilled with your response to her log. She said that you're going to be sorry, though, because she wrote twice as much in her log today.... She had this almost astounded look on her face that somebody would attend so closely to what she had written. She said "Did that ever make it worthwhile keeping that log". (S. R., DB940119, pp. 10-11).

She told Bob and me at the end of the TPD P that looking back in her journal at her year's work in science made her feel really good, to see how much she had accomplished. 

Sharing it with me was important to her:

Clare wrote nice letters back .... When I read these letters, it makes it feel like it was worthwhile doing this [keeping a journal] 'cause so many times when you keep track, keep notes and things like that, the book goes on the shelf and doesn't get looked at again .... I mean, how often do you go back to read your own notes? But because Clare had written beside my notes, they became valuable .... Somebody else appreciates me. It was really neat. (E. Y., DK940421, p. 2)

Two Classroom Visits

Visiting classrooms gave Bob and me the opportunity to observe how teachers implemented teaching strategies that were new to them. The experience of Hans, a primary teacher, gives a good illustration of a teacher conducting a lesson based on an activity with which he was personally familiar from prior experimentation during a TPD P workshop, the candle-in-the-jar.

The planning team had prepared enough materials for the teachers to take back to their classrooms and the distribution of materials went smoothly. Hans arranged them on a large table at the front of the room: 6 pie plates, each with a candle fixed in the center with melted wax, 6 litre-sized jars, a pitcher of water. As the children distributed materials among the tables, children at the tables touched the unlit candles, ran their fingers over the wax, and dipped their fingers into the water. Hans listened patiently as a child commented that if the candle tipped over it would go out because of the water. Another remarked that the liquid in the plate was oil, not water, because look at how thick it was -- it was standing up at the edge.
As children spoke, Hans looked at them, nodding, verifying their questions and comments by repeating or rephrasing, accepting all questions and answers without judgment. In so doing, he reminded me of Bob when we had done this activity with the teachers. Next, Hans asked the children to predict what might happen once the jar was inverted over the candle. "The candle will go out", a child replied. When all candles were lit, Hans announced that when he gave the signal, one child should place the jar over the candle and all should watch carefully what happened. Bob turned to me and said quietly that science doesn't get much better than this, and sat with a group of children at a table.

My attention turned to the table where Bob sat. The children's excitement and anticipation was high. A girl looked hardly at all at the candle but gazed all around the room at the flickering lights; a boy ran back and forth to the adjoining table to see what was happening over there.

There was a great sigh of delight from many children as the candles went out. Then excited chatter started up and the teacher asked the children to share what they had noticed. Children observed that the water was bubbling like lava, that water was going in and bubbles were coming out. The children offered explanations for why the candle had gone out, such as, "It didn't get enough oxygen, like in outer space" and "There was water going up the side of the candle." Each time an observation was offered, Hans accepted it by rephrasing or echoing. When he asked, "Would you like to do it again?" there was an instant loud "Yeah" from the class. The children set up the experiment again and Hans suggested they look very closely to see if they could notice what other groups had noticed, or something different. The children confirmed their previous observations and shared new observations. One group had noticed that the jar had begun to burn. How did they know? They rubbed off a bit of carbon from the inside of the top of the jar and produced it as evidence.

Hans had not previously made science a priority in his teaching; he told Bob and me that his personal goal for the year was to have at least one science activity each week in
his class (H. S., LG940407). Despite his inexperience in teaching science, he seemed relaxed and confident as he re-enacted the workshop activity. The teacher encouraged open-ended responses and appeared interested and excited by what the children noticed. The children appeared to find the activity fascinating and satisfying (OB931104).

In January, 1994 Bob and I observed a much different science lesson, one derived from a textbook. Teresa taught a lesson she found in a unit called "Chemistry Kaleidoscope", using materials she gathered herself. Her experience with "Mystery Powders" gives a vivid snapshot of a teacher grappling with her first hands-on science lesson derived from the school's science textbook series, Innovations.

The children sat at their desks in groups of two or four. Teresa asked that each group of children choose one person to come up to get one textbook for every two children. This sharing was necessary for there was not a class set of student textbooks available. The teacher then gave a rather complicated description of what children were to do, speaking loudly and with great assurance.

Teresa told the children that she had arranged the science materials in four different corners of the room, to be collected later by one table monitor. She talked a bit about each material, particularly the iodine which, she said, was a dangerous/poisonous substance, so she would be the one dispensing it. In fact this did not happen — the children circulated the jar and used it responsibly. She stated that the instructions in the textbook called for aluminum pans but she had been unable to get any so had decided to use four plastic glasses for each group of tables, which she had marked A, B, C and D. However, she said, these letters should be disregarded since, in fact, the children would be using four different tests -- or was it four different powders? -- upon which confusion erupted.

I quickly scanned the text and suggested to her that 16 glasses might work better since four powders and four tests required $4 \times 4$ glasses, particularly since some tests required leaving the substance undisturbed for 15 minutes. I added that it might be a good idea to have the children do only one powder and four tests rather than all 16 tests, especially
since each group would need 16 glasses. Without missing a beat, Teresa decided that each group could choose to do four tests on one powder, or one test on four powders, in which case they would need to make three more charts, or fill in the same chart, and so on. I found these directions terribly confusing, but the children seemed to catch on fast and drew their charts quickly. The class continued; periodically Teresa stopped the children to give more directions, but not to rebuke. She seemed imperturbable and confident.

Nearly 40 minutes passed from the introduction of the lesson until all children were involved in the hands-on work. Teresa announced that she had decided to not have French that day since it seemed the children were just getting going and it was apparent that they would not finish in time to have French; they were to continue to work until they were finished. Bob signaled to me that we should leave and we did, with me thinking that she was a good-humored and very brave woman, for that was not an easy lesson (OB940106).

Although she had done hands-on science with primary children, Teresa had little experience presenting such activities to upper intermediate children, and had not taught this textbook lesson before. I spoke with her later about her classroom experience; she hadn't lost heart and felt that her lessons were going better. She told me, "I make myself do it [hands-on science]. The kids are more used to it" (T. F., S940203, p. 8). She recollected the Mystery Powders lesson in an ironic tone.

(laughing) Leanne and I were flipping through [Innovations]. I . . . said, "Leanne, look at this! It's Magic Powders!!! I did Magic Powders in primary! I made ooblik. Oh, this is great!" and got all enthused. So we met and she said, "I'm not sure I want to so this" so I said, "Come on, Leanne, I'll get this, you get this." I did the stuff at home . . . and it worked really well and it seemed really easy . . . But I didn't realize all the things I had to have prepared . . . . Well, the minute I saw the looks on their faces and the gleam when I started to explain . . . . (S940203, p. 7.)

Learning Through Reflection and Discussion

A need to debrief with teachers. Following these classroom visits, Bob and I left the school without having a debriefing session with the teachers, as they had to continue their day's program. We regretted this omission; as Bob said,
We had just had a marvelous experience, the three of us, in that classroom. The richness of what could be gleaned from that experience in terms of sitting down as a threesome afterwards! . . . It's frustrating not to be able to discuss it". (R. C., DB940105, p. 32)

With Steve, we decided that funds were needed to hire teachers-on-call so that teachers could be released to talk with us after our classroom visits.

**Teacher knowledge derived from experience.** During such a debriefing session, I spoke with Teresa about her Mystery Powders experience. She told me some of what she had learned from that experience and others. While her newly developed knowledge, described briefly in the next section, is recognizable as something that "every" experienced science teacher knows, the important thing is that she came to the knowledge through personal experience.

Teresa commented that she learned about the length of time needed for a hands-on science lesson, and the importance of organizing materials for easy distribution.

> I've learned science is more than a 40 minute block. You need at least a double block . . . . I find that if I don't do the double block giving myself time to finish, and come back 4 or 5 days later, they lose the momentum. I've learned that this year. You have to finish what you start immediately. (S940203, pp. 7-8).

Teresa and Leanne tried different sizes of instructional groups.

> I find it tough to do a group lesson with everyone sitting and watching . . . . Groups of four is too many, they get waylaid. Groups of two seem to be the ideal number . . . . [But] it kills you for getting materials! . . . We started trying with [larger] groups but that takes a lot of training and they lose it . . . . You saw it the first time [the Magic Powders lesson]. I revised it and did it with two, and it worked better. (T. F., S940203, p. 6)

She and her teaching partner changed their expectations about the locale of learning.

> Kids find their own places. Like yesterday Leanne was saying she was missing one of her kids. So she went out in the hall, and . . . [the girl and a partner] were working quietly, and it was a child who doesn't participate, doesn't hand in anything. And they had taken themselves out in the hall and were working. (T. F., S940203, p. 6)

These changes in classroom teaching were not always easy, however.
Steve has seen me come out of there pulling my hair saying, "I'm not going to do this again." They have done the science experiments in the bathroom and everywhere. (T. F., S940203, p. 5).

Teresa's statements convey the delight in her successes and confidence in her judgment.

In a workshop in February, 1994 Teresa and Leanne talked about how they tried assessment strategies suggested in Innovations in Science. Leanne began with a statement which reveals a shift in attitude from deference to the experts, to confidence and pride in practitioner knowledge.

I'll start by saying what we're supposed to be doing, because it's totally different from what we actually did . . . . I guess you're all familiar with this part of the binder [the Innovations Teacher Resource Package] . . . . At the back is the section on evaluation and they have all those charts, observations of growth in all those skill areas. They are all based on a 1 to 5 scale and you're supposed to be walking around and checking these off and assigning numbers to your 32 students . . .

Teresa interrupted, "For every child!" and Leanne continued,

. . . as you see them work! That's why we haven't been doing what you're supposed to do because I don't think it's possible. We haven't found it to be possible yet. We've done quite a bit of hands-on work and found that it requires so much of your attention to make sure that the classroom doesn't explode that I really don't think there's any way you could physically do this.

Teresa expanded,

They want you to watch a lot and observe the children talking but we can't even walk around our classroom, let alone carry our clipboard. (SK940202, pp. 1-2)

They continued, critiquing the textbook's strategies, describing some ways they had begun to look at their children's learning, and presenting alternatives that they had developed that did work for them. They concluded by saying they had learned a lot from their efforts (SK940202).

Other teachers, too, spoke with authority in workshops about science teaching, and their colleagues listened to them with respect. This contrasted with the beginning of the TPDP when teachers viewed Bob, Steve, Nick, and me as the experts, looking to us for the answers to their questions and the solutions to their problems, and for approval (or criticism) of their science teaching. Whereas workshop discussions at the beginning of the
TPDP were generally either delighted accounts of how much fun teachers were having or an acknowledgment of anxieties, later discussions were a sharing of classroom-based expertise as teachers became more comfortable and confident about teaching science.

In a workshop in February, 1994 Lily and Hans talked about how they managed materials and time when they team-taught an *Innovations* unit on "Rolling Things". They mentioned how they found planning together a great time saver as they shared the work of gathering materials. They told the group that it was necessary to use the gymnasium to provide enough space for the activities (CL940202). As these teachers spoke, their colleagues listened respectfully, offered suggestions, and asked questions for clarification or explanation.

*Our classroom presence fades.* Requests for Bob and me to visit classrooms diminished towards the end of the TPDP and there were several times when I wandered rather aimlessly on Thursdays since no teacher requested my time. The last classroom visit by Bob or me occurred during the Thursday prior to Spring break. At the time, I wondered why so few teachers took advantage of our offer to visit their classrooms; comments made by teachers at the end of the year shed some light on their reluctance. They talked about such difficulties as inflexible timetables structured around gym time and computer lab bookings, making it hard to schedule impromptu science lessons. They said that the numbers of children cycling in and out of their classrooms to receive learning assistance made it hard for teachers to teach a coherent science lesson at certain times of the day. Teachers also said they were reluctant to sign up for teacher release time because they felt very busy and didn't want the pressure of preparing for a teacher-on-call in addition to preparing a good science lesson (CL940202; RT940504). Perhaps they were becoming weary of the endeavor.
A Full Year of Teacher Professional Development

Time for Change

The TPDP was structured to extend over the school year so as to provide teachers with ongoing support as they introduced changes into their classroom practice. Although a series of 2 hour workshops over a school year seems an incredibly long time, it really wasn't. The planning team was constantly aware of a time pressure and always planned too much for each workshop. The temptation was to pack a lot into each workshop so that teachers would have lots of activities to take back to their classrooms, but that risked losing depth in the teachers' own learning. The planning team discussed this dilemma after a workshop. Bob observed, "We're over-programming ourselves. I've never been so badly off the mark in my life as I've been" (R. C., DB9312103, p. 8). Thereafter we made a deliberate effort to slow down.

Teachers commented at the end of the year on the positive aspects of a year long program, such as David, who said, "Having it on site at regular intervals is that you get an idea and apply it immediately . . . It makes a big difference to have it at intervals during the year" (D. T., RT940504, p. 8). Bonnie explained to Bob and me earlier, however, that the year had its ups and downs.

The staff went like this throughout the course. Keen. Then, "Oh, my God, this is taking a lot of time." "Oh, that was good." "Oh, I've got a project to do; is this the last class?" And then yesterday we thought, "Oh, [today] we've got 3 hours" [a longer workshop than the usual 2 hours, to accommodate an APASE workshop]. . . And at the end of yesterday's project everyone was on kind of a bit of a high. Like, "That was great!" and they worked together and they got a sense of, you know, how this could really work in their classrooms . . . . I just found that the staff really was up and down, and up and down, and they'd get on these little highs and really committed, "We're going to sort out the science equipment." And then we would come up against a barrier of some sort and then it was like, [sighs] "Maybe we shouldn't have taken this on." You know [laughs]. But I think for the most part everybody's ending off on a note of, they learned more than they thought they were going to. (B. F., EJ940421, p. 1)
A question in the vice-principal's end-of-year-survey inquired into this aspect of the TPDP asking, "As part of this project, we met about 13 times over a period of 7 months for a total of about 35 hours. Do you have any comments to make regarding the frequency, spacing or duration of these meetings?" Classroom teachers responded with words such as "Good", "Perfect", "Fine" and "Excellent". One non-registering teacher commented, "Spacing of meeting times was good, but it went on a bit too long. Would have preferred ending it in April." Another non-registering teacher saw little immediate relevance of the workshops to her teaching assignment and was relieved that the course was over; she commented that while she had found the course interesting, professional development in science was not high on her personal list of priorities and commented, "I often felt frustrated as it was a lot of time spent on something I wasn't directly involved in." To my knowledge she, unlike the other non-registering teachers, did not work with a classroom teacher on a science project during the year. She alone of the non-registering teachers was not taking the course for credit; the others found ways to incorporate science into their teaching assignments so that they could complete a science project.

A Need for Ongoing Professional Development Activities

While there was no clear vision of what might occur in the third year of the 3 year project, the school growth plan included the school year 1994-95 as a second year of staff development and training, for the wisdom that Bob and Steve developed in part during the DESSIP told them that one year of teacher professional development activity would not be enough to firmly anchor lasting change (Price, 1990; R. C., CR930917).

Towards the end of the TPDP, teachers and administrators began to talk about the following year. A number of teachers wished to continue so as to sustain aspects of the TPDP they had enjoyed; they told Bob and me that they got a lot out of the course and hoped to continue in a similar fashion for another year. They talked about how they had come to enjoy the camaraderie during workshops and hoped that it could continue the following year. As Jacqueline said,
It was nice just to have people around and be close to them and hear what they had to say. Next year if we all work in our own classrooms and don't necessarily meet to prepare things, science stuff, I'm just afraid that I'm going to be isolated again and I'm not going to have the group to kind of pep me up and get me going. (J. K., D940407, p. 9)

For several teachers, the motivation to continue was enhanced by the possibility of working towards a further three credits.

At the end of the year, I asked teachers,

We've heard that one-shot inservice is not enough, that nothing really changes, so then we think one year is enough. Is one year enough, or should it be going on continually for teachers? (C. B., RT940504, p. 7)

David summarized thoughts that were shared at this session by referring to what other teachers had said.

I think it [one year] is enough for instilling confidence. . . . I feel more confident . . . so that part won't change. But for myself, the excitement about it might change a bit since you can't look forward to sharing with other teachers and getting ideas from them, like the egg-in-the-bottle. . . . But overall, we have made changes within ourselves. (D. T., RT940504, p. 7)

Three other teachers continued, adding to each other's words.

I think what David is talking about is maintenance of self-directed exploration, but I think there would be a difference . . . . I do, too . . . . Getting new ideas on a regular basis . . . . Stimulation . . . . Might be a maintenance thing, but not the growth. (L. N., F. C., & L. M., RT940504, p. 7)

Maintaining momentum. Teachers were worried that without support, with a lack of focus on science, with other pressures intruding, their personal momentum in science would be lost (L. N., KL940407). As Jacqueline said,

I am a little apprehensive for next year, because I am not sure about the support that we will be able to give each other without having you [Bob and Clare] around, and I just wonder how it is going to go, and [I wonder] if all of us will continue to plug in and put as much energy into it. (J. K., D940407, p. 8)

Other teachers sensed that, even after their concentrated effort over several months, they had just started to get on top of the challenges of changing their approaches to teaching and were just starting to see lasting results with their children (T. D., OB940316). Many
questions still hadn't been answered and topics such as assessment and evaluation only just started to be addressed (RT940504).

Some teachers worried that, even if individual teachers could maintain their personal professional growth, the school wide improvement effort would falter. In a March, 1994 workshop, David expressed concern about the maintenance of the effects of the school-wide initiative.

How do we maintain our science momentum? With the pro-d [days] next year we can address it, but we won't be involved in it as much as this year. That to me is a big concern, the difficulties with the one-day workshop. I don't want to be pessimistic, but we all have to face it . . . How do we continue to maintain it without taking away from the other stuff which will seem more important next year? (D. T., CL940318, p. 1)

Steve and Bob anticipated this danger in November, 1993. Steve said,

Neat things are happening around the school with science as a result of this project. But . . . to be a pessimist for a moment, those things are happening within a particular context. They're happening within the context of this project occurring, with this kind of support going on and this kind of encouragement . . . . When that context changes then [I fear] so will the activities . . . . What we need to think about is what can we do this year or for next year. What can we do in order to make sure that some kind of positive effect and the measurable observable change is still there 3 years from now. That's hard. (S. R., DB931103, p. 18)

Bob replied,

The most pessimistic thing of all is that nothing will ever continue to occur unless you continue to have this sort of thing going on. (R. C., DB931103, p. 18)

Hopes for the Following Year

While a full year for science professional development seems like a long time, staff comments towards the end of the TPD showed that, for many teachers, one year was not enough to consolidate the changes. Steve expressed the hope that there be a way

to continue this some way or another . . . through the next school year, because I think there are people who need . . . support, many if not all, in order to consolidate [their learning]. (S. R., DB940316, p. 15)
The staff did achieve its objective for making science more frequent, more active, and more student-centered; however, as Teresa said, "Next year is quite important because there are so many things that aren't quite finished, because of questions we still haven't answered" (T. F., RT940504, p. 10). At a workshop in March, 1994 Steve asked the staff to consider how support might continue after the TPDP ended and, at the final workshop, teachers shared their ideas (FN940504). Steve conducted the discussion.

There was general agreement that Marjolaine and Marion's efforts to organize the school's science materials had been very helpful and much appreciated. Teachers were concerned, however, that the two teachers would not be able to keep up their commitment to provide that service to the rest of the staff throughout the next year. The group suggested that Marjolaine and Marion be given some teacher release time so that they could continue to look after materials and that the science storage room be renovated so that materials still arriving could be put away.

A teacher proposed a science retreat weekend at an outdoor school to kick off the following school year (1994-95). This suggestion was greeted with smiles and enthusiasm, indicating that teachers would look forward to engaging in a staff activity that would sustain some of the camaraderie they enjoyed during the TPDP. Another idea was that teachers continue to meet on a regular basis to show and share what they were doing in their classrooms, perhaps taking turns setting up hands-on activities in the large multi-purpose room, to be used by all classes who wished. David pointed out that the real question was what the staff would choose to do for their professional development the next year; he suggested that perhaps one professional development day could be used for another Project WILD workshop. Nick pointed out that there were only three professional development days to be allocated. His statement, following on the heels of an all-year effort that we still felt unfinished, highlights to me how inadequate is the time allocated for continuing teacher professional development in the regular school year.
At other times, a number of teachers expressed a hope that Bob and I continue to visit the school the following year; as Marion said, "Even if you could just come just a couple of times, it would make a lot of difference, I think, for a lot of people" (M. Y., LJ940421, p. 1). Teachers expressed their hope that they might earn course credit the following year (T. D., OB940316; J. K., D940407; T. D. and J. N., SA940421). Bob liked the idea; as he said to a teacher, "To go on for another year would be unbelievably rich . . . . We could have a wonderful seminar" (R. C., LJ940421, p. 1). Now, at this final workshop, teachers asked, could another course be offered? A show of hands indicated that nine, perhaps eleven teachers would be interested in a further credit course, with four or five more interested in participating, not for credit, but out of interest.

Other, More Pressing, Needs

Ellen put a damper on tentative plans by pointing out that much would be going on the following year, the biggest one being accreditation. Staff members were aware of what a big undertaking this would be and that it would be the staff project for the year (S. R., DB940316; L. N., KS940421). This and other demands resulted in a shift of the staff's professional development priorities and the science initiative was overtaken by more pressing needs.

New parental concerns. In a roundtable discussion with five colleagues and me at the end of the year, Teresa expressed satisfaction that the parents of her children were generally pleased with the science program she had provided, but commented ruefully that, in the following year, "Parents will find something else we're not quite up to par in." Her statement was greeted with laughter and another teacher commented, "They already did -- music!" More laughter as a third added, "Next year we'll be making instruments!" (RT940504, p. 6). This criticism of the music program came in part from parental disappointment at the cancellation of the band program (a decision not related to the TPDP) and the highly visible concentration on science. "So now parents are sending notes [asking] 'What is your music program?'" (T. F., S940203, p. 10).
The School Year 1994-95

At the invitation of the staff, Bob and I did return in Fall of 1994 to offer a second part of SCED409 for those teachers interested in receiving further course credit. At this time, the teachers showed us with great pride how the materials issue had been resolved: Impractical cupboards were replaced with ample open shelving; materials were neatly sorted into bins and labeled and a sign out system was in place. Bob and I were happy to see that this teacher-led initiative had been carried to completion.

Bob opened enrollment in the proposed course to any elementary teachers in the district interested in joining our group. Despite strong teacher interest during the rush of enthusiasm at the end of the TPDP, not enough teachers enrolled to meet the minimum requirements of The Office of Distance Education, even with the addition of several teachers from a town 40 minutes away. We canceled the course with the promise that we would try again in the next term. We returned in January, 1995 to an even lower turnout. It seemed that accreditation and other demands forecast by teachers the previous year sapped their interest in continuing professional development in science in a university course format.

However, three Mountainview teachers were disappointed and persisted in asking us to return to help them continue their studies of science education; specifically they requested a focus on issues of assessment and evaluation. Bob and I returned to run a small seminar group on assessment and evaluation. During our visits, I saw very little of the other teachers who had participated in the TPDP; even Steve and Nick were not often in evidence and I missed their warm welcome. This is not to say that the seminar was not a rich experience for the three teachers and for Bob and me; it was certainly that and the intensity of meeting in a small seminar group was exciting. But for me the flavor of this course was different from the exuberance of the school wide effort; clearly the staff's attention was elsewhere.
Sparks and Loucks-Horsley (1990) argue for the importance of a supportive organizational context for effective staff development in terms of organizational climate, leadership and support, district policies and systems, and participant involvement. I discussed the latter with reference to Mountainview Community School in chapter 3 when I examined the change process of the TPDP: how it was rooted in needs identified by staff members and designed by them to address a school objective; the first three I discuss here.

Sparks and Loucks-Horsley (1990) describe a supportive organizational context thus:

Organizational climate characterized by:
- teacher-administrator harmony and a supportive working relationship.
- administrators who minimize status differences between themselves and teachers and promote informal communication.
- norms of collegiality and collaboration.
- norms of experimentation and professional risk-taking.

Leadership and support characterized by:
- active support and involvement of principals in teacher staff-development.
- administrators who take a leadership role, provide the direction needed to engage teachers in new practice, and exert a strong and continuous pressure for implementation.
- leaders who recommend high quality, effective practices in change initiatives.
- a team approach to planning, including teachers and external consultants.

District policies and systems characterized by:
• a school district staff development program which includes school goals and accompanying action plans.
• resources allocated so that goals have a reasonable chance of being achieved.

Each of these characteristics was apparent during the TPDP; some predated the TPDP and others developed during the TPDP for, as Sparks and Loucks-Horsley (1990) say,

Staff development both influences and is influenced by the organizational context in which it takes place. The impact of the staff-development models . . . depends not only on their individual or blended use but also the features of the organization in which they are used. (p. 247)

Organizational Climate

Teacher-Administrator Harmony

A supportive working relationship. According to the administrators, prior to the TPDP they had a supportive working relationship with the teachers which continued throughout the TPDP. The administrators had an enormous respect for the teachers and worked hard to make the teachers' job easier. Nick said he hoped to develop

a better insight into how we can help people do their job . . . 'cause what we've got here is a group of people who desperately want to do a good job, and are working their butts off in an effort to do it. (N. F., DB931103, p. 42-43)

Nick monitored the teachers' welfare and the progress of the TPDP by participating in every workshop and watching his staff members closely. His observations helped us plan workshops and helped the administrators support teachers as they struggled to try new ways of teaching. For instance, at the first workshop, Bob told teachers that we would leave journal articles with Steve for the teachers to read before the next workshop. Bob hoped that the articles would stimulate reflective conversation about teaching in the following workshop. At our debriefing session, Nick suggested that, at the next workshop, we ask teachers to talk about their classroom experiences in the context of these readings, for "then the people who didn't do the reading can fake it by talking about their classrooms" (N. F., DB931006, p. 32).
After a Fall workshop, Nick suggested that we not give the teachers too much to do between workshops; he observed about the teachers, "They're very tired and they're very distracted and they're very busy" (N. F., DB931103, p. 19). Nick commented that he and Steve had "gone out of our way to encourage teachers when they've come to us, and [we've] said, 'Rest, you're doing enough!'" (N. F., DB940316, p. 11). Such reflective and insightful comments in debriefing sessions revealed both his concern for teachers' welfare and his commitment to the success of the TPDP.

I observed how Nick watched over his staff at other times during our visits, too. On a number of occasions, he dropped in on Bob or me on what I believe was a pretense, as we worked with teachers in classrooms or chatted with them after school. It seemed to me that he was checking that the teachers felt comfortable with us. For instance, as I talked with Jacqueline in her classroom after school, Nick entered quietly, appeared to look for something on her desk for a few minutes, and then left (FN940106). On another occasion, I sat chatting with Teresa and Leanne about their team teaching; Nick interrupted our conversation to ask them which of the teachers was the primary representative (S940202).

Nick dropped in on Bob, too, while he was working with Lily in a primary class. Bob and the teacher recalled this incident later in the year with some delight, during a discussion of what constitutes off-task behavior in children's explorations. They viewed Nick's appearance not as an intrusion but as somewhat of an embarrassment for, when Nick came in, Bob was sitting with a group of children and had magnets stuck on the end of his nose! He and the children had been investigating, albeit informally, whether the magnets' effect could be felt through objects, and were adorning their faces with magnets to make masks (KS940421). This concerned, almost protective, attention to the teachers' welfare (and perhaps ours) was characteristic of Nick's concern for the staff and the well-being of the school and children, and consistent with the administrators' commitment to making the TPDP as easy on the teachers as possible.
Administrators feeling trusted by teachers. Nick and Steve felt the teachers trusted and respected them and believed that any decisions they made on the teachers' behalf, even without consultation, would be accepted. They saw their decision making as one of their responsibilities as the school's administrators (RK940203). The administrators talked to Bob and me about trust before the first workshop. Nick said,

At the risk of being immodest... we have come to be regarded, I believe, by the staff, as providing some fairly good leadership and some strength. So if we think it's a good idea, they tend to go along with us... Most of them, some of them, suspend judgment and simply go along with us because we suggest it. And I think we've earned enough trust that they're willing to suspend their own doubts and concerns and go along with us... I think for many of them, they believe that this [the TPDP] is going to be good, and good for the school, because Steve and I said it is. (N. F., PL930917, p. 3)

Steve cautioned however,

If Nick's right about that sort of trust, and he probably is, it's easy to stretch that too far... That may allow us to initiate something, but if, in fact, you don't carry it off very effectively, that trust is going to be withdrawn fairly quickly because we're not dealing with stupid people here. (S. R., PL930917, p. 3)

When I asked them if one of their administrative responsibilities was to make recommendations about what would be good professional development, Nick agreed, but Steve commented on how they arrived at their recommendations.

Our impressions of what might be good for this school are developed, in large part, by talking to the staff. Now, they're also developed by talking to the parents, they're also developed by being aware of provincial test results, they're also developed by visiting classrooms and seeing what's going on and looking at hallway displays and listening to parent complaints and compliments and all that sort of thing. But it would be misleading to suggest that the science thing is strictly an idea that Nick and I came up with in isolation of the other staff members because, in fact, the staff members, on their own--many--have said that science is an area that needs concentrating on in this school. I mean, as soon as I arrived in the school, in fact I think when I was being interviewed for the job, it was mentioned. (S. R., PL930917, pp. 3-4)

Although they felt trusted by teachers, Nick and Steve wished for more open discussion among staff members so they could have better feedback concerning initiatives...
they proposed to the staff. Before the TPDP started, they told Bob and me, "We pray in our staff meetings, when proposals are being examined, that somebody leaps to the floor and says, 'This is totally senseless'" (N. F., PL930917, p. 27). Towards the end of the TPDP, they rejoiced in changes they noticed in staff relationships; as Nick reminded Steve,

> We talked about it: If we could change one thing in the staff meetings, what we would like them to do is, when there is a blatantly silly idea on the table -- For God's sake, what's your comfort in having 18 people who agree with you? 'Cause all it really means is you don't know you're wrong. (N. F., DB940316, p. 6)

Steve added,

> Or they're not thinking about what you're saying at all, or they've thought about it and they're not willing to say anything, or they're going to do what they want anyway. None of those three options is very attractive in a healthy productive, open collaborative staff. (S. R., DB940316, p. 6)

While the administrators felt they had a generally harmonious relationship with teachers prior to the TPDP, they felt relationships among some teachers were strained.

**A Need for Stronger Collegial Relationships**

**A growing professionalism among staff.** The principal spoke about the development of "professionalism" among staff on a school-wide basis during the TPDP. This professionalism, he said, was characterized by a "high level of mutual respect" (N. F., DB940316, p. 6). He commented to the planning team after a workshop in March, 1994,

> There's been a tremendous amount of professional growth here. It's a professionalism that I was really never sure could exist in education. I was starting to despair of it . . . What was neat about today was an extremely high level of professionalism and none of it affected; . . . such a high level of mutual respect. (N. F., DB940316, p. 6)

The administrators welcomed this change for, as Steve recalled,

> When I first arrived on this staff about a year and a half ago, the sense I got was that if you had said in a staff meeting, "Okay, we're going to devote the next hour . . . to a discussion of, say, language arts instructional methods", . . . what you got was shifty looks. Like this. And when someone built up their nerve to say how they felt about a certain aspect of language arts, you would have got people thinking things like this: "So, she thinks she's the expert". (S. R., 940316, p. 5)
Nick interjected that that would have been a good meeting, that he would not be exaggerating by saying, "A more typical meeting would have been, as soon as you trotted out your little suggestion, 'Went to a workshop, learned this', three people would have ripped your throat out" (N. F., DB940316, p. 5). When Steve proposed to Nick that this might still happen at a discussion of a topic other than science, Nick disagreed, saying, "I don't think so" (N. F., DB940316, p. 5).

Sources of respect. The planning team discussed how we might foster professional respect in the TPDP. By engaging teachers in hands-on activities, we put teachers on an equal footing with one another regardless of their previous expertise in science. By encouraging them to share not only their teaching triumphs but also their classroom problems, we set the expectation that teachers engage in thoughtful conversations about professional practice. Nick attributed teachers' honest and intense participation in these discussions to their shared experience of science in their classrooms with real live children doing real live things. They are all struggling with the same thing so they were more than happy to throw out their ideas and relax and talk about it. Good, in-depth, meaningful discussion in the whole group. It's the fact that they took on something that almost every one of them felt somewhat inadequate about. They've gone from that to feeling really quite competent. (N. F., DB940316, pp. 2-4)

Following one workshop discussion, Nick observed that views of all groups on staff had been represented. Not every teacher spoke in the large group but, as Nick said,

What's neat [about] today is that you had representation of every group in the school. So that it was primary teachers who spoke, and they had something to say to intermediates; intermediates had representation, they spoke. Special education and learning assistants had a meaningful contribution to make, they really did. I mean, they were engaged and they weren't offering esoteric advice, they were offering real live, "This is what we have to do to make it work for the kids that we're responsible for". (N. F., (DB940316, p. 4)

During this discussion, teachers advocated their own points of view while acknowledging those of their colleagues. The administrators had tried to establish such open discussion in
staff meetings in previous years, but had not succeeded (CH940316). Towards the end of the TPDP, Steve pointed out to Nick that he had contributed to establishing this context.

You allowed that to happen, because basically what you've done as the principal of the school is, you've sat there around the table with everybody every session and you've participated in all the little hands-on activities and everything . . . . You've made yourself their equal, which means that you're not anybody that they can't be as critical of as they feel free to be with their colleagues, because you've made yourself one. (S. R., DB940316, pp. 6-7)

Bob voiced his agreement with Steve's analysis. A statement made earlier in the conversation shows how important the establishment of this reflective community was to Nick as an outcome of the TPDP. He said to Bob and me,

Heck, I thought today, if you guys were looking for a way to evaluate the project, there's your evaluation . . . . The way they engaged in discussion, all of them; they were leaning forward, they were attending . . . . (N. F., DB940316, p. 3)

Changes in Staff Relationships

Camaraderie in workshops. Teachers talked about the camaraderie that developed in workshops, alleviating the professional isolation they felt prior to the TPDP. They spoke about the encouragement and support they received from colleagues as they tried an approach to science teaching that was new to most, and about the team planning they did as part of the TPDP. They enjoyed getting together regularly with colleagues with whom they previously spent little time. They shared feelings of fun and excitement while exploring science activities in workshops; they shared their anxieties and triumphs as they discussed their classroom experiences; they encouraged and supported one another as they planned and implemented science units; and they worked together to identify and address issues in science teaching at the school.

Fun in workshops. Teachers looked forward to the fun we'd have each time we met and workshops took on an aura of a social gathering of friends enjoying science together. At the end of the year, a group of teachers recalled that workshops had been fun and relaxing and that they had laughed a lot (RT940504). Teresa commented that, in
photographs taken by Nick, "We look like we're having a good time" (T. F., RT940504, p. 10). "And we played," added Frances. "When was the last time we had time to play?" (F. C., RT940504, p. 15).

Teachers spoke frequently about the benefits of team planning and team teaching. Several teachers spoke about a sense of community that emerged during the TPDP; they hoped these sorts of feelings of community could continue in the following year but worried that, without the structure of the TPDP, the new-found sense of community would be lost (T. F., S940203; J. K., D940407; M. N., LG940407; T. D., SA940421; FN940504; RT940504).

Workshop partners. I noticed in workshops that, while a few teachers sat and worked together throughout the year, others moved to new locations in the room, and partnered with a variety of their colleagues during hands-on activities. Nick thought some of these partnerships were unusual staff alignments (DB940202). Jacqueline commented at the end of the year, "I ended up being paired with Hans. That was great, I never had a chance in 3 years [previously] to do anything with Hans, other than saying 'Hi' in the hallway." Lily added, "It's a sad thing about this job, isn't it?" and Teresa said, "You work in the same building but you don't necessarily ever see each other or talk to each other" (T. F., RT940504, p. 9).

Alleviating teacher isolation. Teachers talked about how they lost the feeling of isolation as they struggled to try new approaches to teaching science (T. D., SI940421). Marion in particular felt supported just by what she referred to as mental or emotional support, the knowledge that she was not alone in her struggle to try new approaches, and the sympathetic acknowledgment that her growing pains were okay. She felt that she had come far with support.
You didn't feel like you were out in left field, giving this a try all on your own. Everyone was sort of suffering through it the same way or dealing with it the same way. I found it made all the difference, not so much that you always had someone to talk to about it and you didn't need someone to talk to, but you knew everyone else in the school in their own way was going through it. (M. Y., JL940421, pp. 1-2)

She told Bob and me that if things had got really out of hand, then she knew that help was close by.

It made a lot of difference for me to know that I could get help . . . . I always knew in the back of my mind that if this totally started to fall apart I had someone I could go to and say, "This is totally falling apart; what am I doing wrong?" [laughter] . . . It was nice when you [Bob and I] were here. So often you go . . . to a conference and say, "Okay, I'll try all these things. I'll try these things when I come back" but you don't want to quite try it because you know there's no help. Like the conference is gone and the speaker's flown back to Texas and if this doesn't work, what do I do now? (M. Y., JL940421, pp. 13-14)

A whole staff effort. That the entire staff was involved in the TPDP was important for some teachers, one of whom told Bob and me about positive changes in her attitudes towards teaching science and her willingness to experiment. When Bob asked Jacqueline whether these changes were outcomes of the TPDP, she replied,

Definitely. The fact that we took the course all together . . . . I would not even have considered taking a science class by myself at UBC, I don't think. It had no appeal to me whatsoever. But having the whole staff take it, I thought if everyone is taking it, then I will take it, and it can't be that bad! (laughter) (J. K., D940407, p. 6)

This teacher, as well as many others, talked about how much she enjoyed the time spent with the entire staff during the TPDP, "Just the fact that we met together and experienced things together" (J. K., D940407, p. 9). Marjolaine enjoyed doing things together, meeting with other teachers and seeing what they were doing, and working together towards solving some of the problems inherent in teaching science at Mountainview (LG940407). Nick and Steve observed in February, 1994 that, when teachers became aware of what others were doing in their classrooms, teachers slower to begin units or projects were given a "kick" to get going (DB940202). Elizabeth said that,
when she heard what other teachers were doing with their children, she could offer to help colleagues, so leading to collaborations (DK940421).

Collaborations outside of workshops. Bob and I spoke with Steve in September, 1993 about how conditions in schools prohibit or inhibit collaboration among teachers. If we wanted teacher collaboration during the TPDP, we would "have to work at it". As Steve said,

The same inhibitions which occur in most public schools against teachers collaborating definitely exist in this school. Some of those are just the isolated nature of the classroom experience for teachers, some of them are jealousies and territorial battles and whatnot that occur between people because of staked-out political and educational positions. All of those for sure exist to some extent between various members of the staff here and will inhibit collaboration. But there's friendships and good relationships and whatnot on the staff as well and that will help to breed collaboration. (S. R., PL930917, p. 35)

The planning team considered how the TPDP might create a context for collaborations. We discussed how funds for teacher release time might provide opportunities for collaboration by avoiding meetings after a busy and exhausting day (PL930917). Some teachers made use of teacher release funds to meet with one another or with Bob and me; others continued to meet at the end of the day (DB940119).

Teaming for planning. The learning-by-doing approach included learning to teach science by teaching a science unit. In January, 1994, the administrators told teachers they must select, plan and teach a science unit. This expectation worried some teachers, who sought encouragement and support from one another. Nine pairs of teachers (Lily and Hans, OB940202; Bonnie and Kelly, SA940421; Kelly and Marjolaine, LJ940421; Leanne and Teresa, SK940202; Elizabeth and Tammy, DK940421; Jill and Tilly, SA940421; Evelyn and Elizabeth, FN940420; Jacqueline and Marjolaine, RT940504; Tilly and Teresa, OB940316) chose to work together on a sustained science unit some time during the year. These teachers planned units, adapted activities to the needs of their children and worked together to solve problems and making improvements to their lessons. Some taught
together in classrooms. Included in this group were non-registering teachers (learning assistance teachers and the teacher-librarian) and a teaching assistant, who needed a venue for a project and "adopted" a class of children with whom to work (CL940119; CL940202).

Teachers talked about many benefits of such teaming. They often described the fun they had and the support they gave one another. Elizabeth and Kelly described how, when working in classrooms with a partner, one teacher could free the other to sit back and observe the children in a way that was impossible when teaching a class alone, giving teachers insights into their children (E. Y., DK940421; K. D., LJ940421). Bonnie, a learning assistance teacher, talked about how, by working with her special needs children within their home classrooms, she came to understand the difficulties of both her children and their classroom teachers in new ways (SA940421).

Long-term teaming. A year-long collaboration between two intermediate teachers started prior to the TPDP. In September, 1993 Teresa and Leanne planned their science for the term together. Even though they did not know one another before the start of school, they wished to plan together for most curriculum areas so as to provide nearly identical programs to their classes, thus reducing the likelihood of parents' comparing teaching styles and criticizing their children's placement. Months later they recalled their September planning for science: They quickly selected some science activities on an environmental studies theme, some puzzles, booklets, questions to be answered, amounting to what they now rather harshly judged to be "busy work" (T. F., S940203, p. 11). Once the TPDP workshops began, they saw they had to be better organized and over a couple of evenings decided what they would cover in the school year for both grade levels.

Both teachers worked closely together for the entire school year and their collegial relationship went beyond unit planning. They became good friends and spoke of the
energy transmitted from their association. They spoke about mutual encouragement and support as they tried the hands-on approach to teaching science. As one said,

We get along well. If something is falling apart in my room, I can run across -- so nice to be across! We share and run back and forth. That's really important. The planning together makes the difference because you talk things out . . . . Plus, we share the load about getting materials . . . . I think a lot more people would be a lot more comfortable if they had someone to work with. (T. F., S940203, p. 12)

Working together towards an objective. As part of the learning-by-doing approach to achieve the school objective, teachers identified issues related to improving science instruction at the school. When Marjolaine broached concerns about science equipment and materials, her colleagues immediately and enthusiastically offered support, suggestions, and help in purchasing supplies (CL940119). Marion joined her to lead the initiative (CL940211, OB940302, CL940318). Marjolaine later said that the developing sense of community during the TPDP had been the motivation to set up a science resource room and added, with some pride, that she and Marion ordered thousands of dollars of science materials (LG940407). Cooperation prospered as the staff worked together to solve a shared problem.

At the end of the TPDP a teacher, who had been on staff for several years, said that the TPDP gave the school a focus that drew the staff together in a way that she had not experienced before. She commented on a school-wide enthusiasm for science, a coherence in planning the school's science program, and a consistency in approaches to science teaching from which the children would benefit in future years (S940203). The vice-principal's end-of-year survey asked teachers to comment on any improvements they saw in staff cooperation and collaboration. One teacher commented, "People seem to have more interest in what their colleagues are teaching -- more willing to share resources and knowledge." Another commented that the interaction with other teachers and an awareness of one anothers' strengths were strengths of the program.
Experimentation and Professional Risk-taking

Bob believed that trust was essential in the development of a collegial community, and that personal relationships are important if change is to occur. Prior to the first workshop, he spoke specifically about his position as an outside agent.

People change if, first of all, they have made up their mind they are going to change. Next, you need some sort of personal relationship with someone [and] things that you can explore. I think it's beyond friendship, it's very trusting, it's a subset of friendship. But you have to have a very good close working relationship with someone. (R. C., CH930916, p. 6)

The next day, he returned to this theme.

I think the element of trust that you have to build up with another human being before they will venture to risk is very significant . . . . It is a slow business, for most people. (R. C., CR930917, p. 5)

Bob worked to create what he called a context in which different points of view could be shared and examined, leaving teachers free to either reject or affirm other views (PL930917).

We are trying to empower teachers to re-examine that triad of things, the adult, the child and the materials, in an environment that is safe, where there is no criticism or failure. If it is judged as such by the teacher, it can be looked at and reexamined as a place where you learn. Teaching no longer becomes a repertoire of things tried and true, it becomes in itself an experiment to try new ideas . . . . [It is] encouraging people to reexamine. That is, I think, where pro-d takes place, where you start to say, "What is it that children know that they bring to their science classes? What is it I know that I bring to my science classes?" and, "How can we together explore that?" (R. C., CR930917, pp. 6-7)

Bob succeeded in establishing a safe environment. For example, at only the second workshop, when Tilly raised her concerns about not knowing The Answer, she was greeted with a chorus of agreement as teachers shared their feelings of uncertainty and frustration with not knowing enough science. Nick commented afterwards on the security evidenced by Tilly's willingness to place her concern on the table in front of her colleagues and ask for their help (DB931103). At the roundtable discussion at the end of the year,
teachers volunteered that they felt safe in workshops and so felt free to bring up problems for discussion with their colleagues (RT940504).

Leadership and Support

Leadership of the TPDP was shared among the principal, the vice-principal, and the university professor. I exclude myself as a leader as I was not responsible for any decision making; I played a number of roles in the TPDP, but leadership was not one of them. As representatives of the school staff, Nick and Steve were responsible for the overall design of the TPDP and for its success in meeting the school objective for science and satisfying the intent of the school growth plan. As UBC course instructor, Bob was responsible for the course content and for meeting the requirements of UBC.

This division of responsibility was not as clear cut as I have represented it, for each leader made decisions in consultation with other members of the planning team. This team approach to planning contributed to providing high-quality professional development to teachers.

Administrators Actively Involved

Nick and Steve saw their participation in the TPDP as a leadership strategy and critical to its success. I recall being surprised when I learned from Steve in September, 1993 that the principal intended to attend all of the workshops despite the fact that he had no science teaching responsibilities. Not only did Nick plan to attend workshops, but he intended to take an active participant role (PL930917). This challenged my preconception of a principal's participation in teacher professional development activities for, in my experience, principals usually introduce workshop presenters, stay for a bit, and then quietly leave. A teacher said something similar when she commented,

Having administrators there was a real plus. At some schools they're not part of it, they don't have time. It was neat that they took the time to be with us. There were many days when they had other pressing things. (T. F., RT940504, p. 9)
In a debriefing meeting after the first workshop, the planning team discussed the administrators' participation.

Nick: I'm . . . delighted by the fact that so many people didn't think we were going to be taking [the course] . . . . Even [the secretary] said, "Will you be taking this course?" Yeah, of course . . . .

Steve: That stunned me -- that there would have ever been a suggestion that we wouldn't take the course . . . . We'd have a lot of trouble with our own credibility if we didn't sit there and fully participate. I think I'd feel like a real schmuck promoting this thing . . . and then not going. God, I'd feel like a real hypocrite. The message being, "This is really important. But it's not important enough for us to be there, but it's really important." It's not a good message.

Nick: In fact, I don't think we ever even thought that we should be there because there's a message involved. No, that never occurred to us.

Steve: No, no! That only occurred to me when I began to consider the idea that we wouldn't be there, which I hadn't. Until somebody else mentioned it. (DB931006, pp. 34-35)

Bob's comment was, "I was so delighted you cannot believe. That is unheard of" (R. C., DB931006, p. 35)

The principal's contribution. Nick led by example in a quiet but powerful way. His wholehearted involvement in the TPDP lent the TPDP an aura of importance to the effort. Steve noted that Nick contributed to the development of professionalism among staff at workshops by participating in all workshops and interacting with teachers (DB940316). However, unlike the vice-principal, he preferred to take a low profile role in the workshops. He participated enthusiastically in the science activities but did not lead any himself.

After the third workshop, when the planning team talked about the roles we were playing in presenting workshops, Bob offered Nick the opportunity to play "a more conspicuous role" (R. C., DB931103, p. 22). Nick's response revealed that he was observing his staff closely at the workshops, and was satisfied with that role. "I'm playing a good role now. I'm very satisfied . . . . I'm really pleased with what's going on and what
we're doing. And overjoyed" (DB931103, pp. 22-23). He went on to talk specifically about the intense involvement of teachers, their thoughtful questions, their enthusiasm. For each, he gave an example of an individual teacher, revealing how closely he had been observing them. Then he said,

I'm going to get an awful lot more out of this if I have the opportunity to watch what's going on. I mean, I'm happy to get up and perform . . . . I have no problem with getting up and doing things. But when you get up and do things, you really are not focused on whatever people are doing. It's a real luxury to be able to sit back and listen to the questions and not have to even respond to them because then you kind of gain an insight about where the questions are coming from. You get a better understanding of the people you're working with. (N. F., DB931103, p. 42).

His insightful comments during debriefing sessions helped direct the TPDP. On the occasions when decisions concerning school policy needed to be made, such as about money for purchasing materials or about school-wide evaluation practices, Nick spoke to staff with authority and finality. His participation in the workshops enabled him to keep a close eye on its progress; I sensed that he was prepared to terminate the TPDP if he judged it was not going well.

The vice-principal's leadership. Steve's leadership was evident before and throughout the TPDP. Nick recalled that he knew of Steve's affinity for science and thought that, if Steve came to the school, they could have "the best darn science program in the district" (PL930917, p. 11). Steve did indeed come to the school the following year (1992-93, the school year prior to the TPDP), and took a leadership role in science. As Nick said,

I knew that we had a leader in science here and that's exactly what he did, he led. And as coincidence would have it, the parents here had spotted early on that one of the weaknesses in the school was a lack of science . . . . Without Steve here, even though the parents continued to press for science, I'm not so sure it would have gotten off the ground. (N. F., PL930917, p. 11)

Steve thought, however,
If Nick had had a different vice-principal who wasn't particularly interested in science, Nick would have probably taken a larger role in this science project than he has .... [But] it's a perfectly sensible way for us to have divvied up our time and resources, and areas of responsibility. (S. R., DB940202, pp. 12-13)

The vice-principal's responsibilities included drafting the school growth plan for science, applying to the Ministry of Education for grant money, and ordering Innovations in Science and science materials prior to the TPDP. He was the originator of this school-university collaboration and acted as the liaison between UBC and the school staff, speaking frequently between workshops with Bob or me, or both, by telephone. He was the program's on-site support and advocate for science education between workshops. He exhibited tremendous energy as he took charge of the details of the TPDP, such as arranging for workshop snacks, procuring science workshop science materials, posting classroom visit sign-up schedules, and issuing science bulletins. He facilitated and presented workshops with Bob and me. He assisted teachers in any way they requested, including visiting classrooms. The teachers knew that this was Steve's project and referred their problems to him, as did Bob and I.

I asked Steve how the TPDP would have been different if he hadn't assumed the role that he did. What if the school staff had simply invited two people from UBC to visit the school to present bi-weekly workshops, and he was not actively involved in the program other than putting on the coffee?

It would be a very different thing. There would be things about it that would work. There might even be things about it that would work better but, by and large . . . I think it . . . would be much less effective. I mean, on how many occasions have we had a communication that went something like this: [Upon phoning Bob], "We decided we're going to do such and such on the next session, but I've been wandering around the building and I really feel that we'd better change that and do this or that"? . . . I think that it's really important at the organizational level to have somebody who is working with these people [in the school]. (S. R., DB940202, p. 13)

In the Fall of 1993, Steve deferred to Bob about leading workshops, for he thought of the series of workshops as a university course and believed Bob should lead them.
In January, 1994 Bob asked to hand over the organizing bits and pieces to Steve and me (CL940105). Steve took a more active role in leading the next workshop, preparing an agenda ahead of time and sharing it with Bob and me just prior to the class (CL940119). Steve introduced the workshop by talking about where the group had been, what we had accomplished, and where we were going, and conducted the remainder of the workshop.

Administrators Providing Direction and Exerting Pressure

An incident after Christmas break provides a good example of how the vice-principal exercised leadership openly during the TPDP, in consultation with and supported by, the principal. It also exemplifies two attributes of leadership identified by Sparks and Loucks-Horsley (1990) as supportive of effective staff development: administrators provided the direction needed to engage teachers in new practice, and exerting a strong and continuous pressure for implementation.

Steve noted during a planning team debriefing session that the planning team seemed eager to turn workshop discussions towards philosophical issues related to differences between child-centered and teacher-centered instruction, between a content and a process orientation towards science instruction, and to the difficulties of evaluating activity-based science. However, he noted, teacher concerns continued to focus on their lack of confidence and lack of science knowledge. Steve spoke to the planning team of his concern.

I'm not even certain that the group has done enough science teaching -- individuals in the group certainly have, but just dealing with the group as a whole -- . . . enough time teaching science in their own classrooms, to actually see [those] question[s] as . . . important concern[s] yet. (S. R., DB940105, p. 14)

Steve discussed this concern again with Bob and me at a second meeting (CH940110). At the second workshop in January, 1994 he informed teachers that, while he knew many of them had science well under way, those who had begun with the egg-in-the-bottle and the candle-in-the-jar and magnetism activities should find one unit that would stretch over
a few weeks and commit to it. When a teacher asked if commitment to a unit was for both credit and non-credit students, Steve replied without hesitating that all teachers had put time and effort into the project so, yes, this was an expectation of all of the staff (CL940119). In our debriefing session, Steve summarized the purpose of stating that expectation:

I think our principal concern and therefore our principal goal for today was to get these people moving ahead solidly on a unit and to establish that as an expectation across the board. I think we've succeeded today, and if we've done nothing else, that's great. (S. R., DB940119, p. 3)

Steve talked about his vision for the school-wide project.

I was really glad that somebody asked that question, "Is this expectation for the credit students?" ... Thank goodness that question got asked, because it gave the opportunity to once again say in the strongest possible terms, that the expectations for everybody are about the same. That we're in this project in order to improve our science teaching and if we're going to do that we all have to make a commitment to be teaching science. (S. R., DB940119, pp. 29-30)

In the debriefing session, Steve asked the planning team for feedback concerning his more conspicuous role.

I should ask you guys your sense of some aspects of that meeting yesterday, because I took a fairly major role in sort of running that meeting: keeping the ball rolling, making announcements, announcing expectations like, ... "You're all going to teach this unit, this is an expectation" ... It's important for me to hear from you guys how the actual operation of those meetings is going. (S. R., DB940119, pp. 28-29)

Bob said to Steve, "I shook your hand at the end of the day, and I did that sincerely. It had to be done and it could only be done by you." (DB940119, pp. 28-30). Steve responded, "Well, it could have been done by Nick. It had to be done by either Nick or I." Bob interjected, "But he had already relinquished the leadership to you ... . It makes great sense for the leadership to be put in the school, and the issue of 'course' is no longer even existing" (R. C., DB940119, pp. 28-29).
A Team Approach, Including University Personnel

While Steve and Nick planned the overall structure of the TPDP and provided leadership for this school-based, whole staff effort, it was Bob who provided the way of working with teachers, through his "negotiated course". Bob assumed leadership for the content and direction of the Fall workshops, for the administrators deferred to him as university course instructor at the beginning of the TPDP (DB931006). However, Bob thought of the TPDP as a school improvement project, believed teachers were in the best position to identify their needs, and envisioned that teachers direct the TPDP. He was adamant that the goal of the planning team was to turn more and more responsibility for planning over to the teachers.

In January, 1994 Bob sensed that the planning team was controlling the agenda of the workshops more than he thought appropriate. He hoped that the teachers would move beyond simply imitating what the planning team decided to demonstrate in workshops, and take a more active part in the planning of coming workshops by participating in an activity that he referred to as a "Q-sort". Bob's stated purpose for this exercise was to have teachers discuss and prioritize what they saw as issues and concerns in their science teaching in order to determine the agenda for coming workshops (CL940105).

Nick commented in March, 1994, "What an insight into adult learning this has been" (N. F., DB940316, p. 7), commenting that Bob had refused to keep the ownership of the course for himself as the teachers expected from a university course. Nick added that it must have been difficult for Bob since the teachers had challenged his position; by insisting that the teachers take responsibility for the TPDP, Bob restored the ownership of the program to them.
District Policies and Funding

A Requirement for a School Growth Plan

The TPDP developed as a strategy to address a school objective included in the school growth plan. The district superintendent of schools required this of all schools as a way to help staff identify areas for growth and create an action plan to address them. Nick said that the superintendent assured him of her support in making the TPDP the only focus for school-based professional development for 1993-94 (DB940316). With this support from the district, Nick and Steve planned an ambitious program.

In a BC Ministry of Education grant application, the vice-principal described the major dimensions of the TPDP thus:

1. All staff (22 teachers and 1 teaching assistant) have agreed to participate in a series of professional development sessions (about 35 meeting hours in total) related to the instruction of science.

2. Two experts in Sc. Ed. (one UBC Ed. Professor, one Grad Student who is an experienced primary science teacher) will be in the school twice a month (on the day immediately following each 2 hour pro d. session) to advise and assist teachers in implementing active, hands-on, inquiry-based classroom science programs. Such assistance may consist of demo. lessons, team teaching, assistance with planning, trouble shooting, etc. Some release time will be provided. (Classroom Discovery Grants Application, 1993).

So described, the TPDP included many features that signal an ambitious project:

- included all teaching staff and both school administrators.
- extended over a school year.
- designated the only teacher inservice at the school for the school year 1993-94.
- included teacher workshops and classroom support.
- included university personnel traveling from a distance and staying overnight in the community.

Funding

This ambitious plan was paid for with:

- school funds.
• Parent Advisory Council (PAC) funds.
• BC Ministry of Education grant money.
• UBC's Office of Distance Education (now Office of Continuing Education) funds.
• UBC's Department of Mathematics and Science Education (now Department of Curriculum Studies).

The TPDP was well-supported financially, giving the program a reasonable chance of success, as suggested by Sparks and Loucks-Horsley (1990). The principal knew the importance of adequate funding for teacher professional development; as he said at a debriefing meeting, "If you're going to spend $14,000 on a new textbook series you probably should have at least $14,000 to provide in-service support for the teachers" (N. F. DB931103, p. 34). At a workshop in March, 1994, he pointed out to the staff that one of the reasons that the TPDP was working so well was that we had lots of money as a result of starting the planning well ahead of time, in the previous year (OB940303). The bulk of the funds originated within the school budget but were augmented before and during the TPDP by the PAC (Parent Advisory Council), The University of British Columbia, and the Ministry of Education.

School funds. The TPDP drew on so-called school start-up money, allocated for capital expenditures in acknowledgment of its location in a new building, as well as moneys earmarked for learning resources and staff development (DB931103). These funds were used to purchase science materials and the science series Innovations in Science, to cover a portion of the travel and accommodation expenses of UBC personnel, and to address the problem of inadequate science storage by retrofitting the science storage room to better accommodate shared equipment (N. F., CL940318). Money from the school staff development fund also paid for the snacks which we felt were so important to the ambiance of the workshops (N. F., DB931103).

Parent Advisory Council (PAC) funds. The Parent Advisory Council showed its support for the TPDP by earmarking $3000 for purchasing science materials for the school
A parent arranged that Bob and I would be able to stay at a local hotel at a discounted rate on each of our overnight visits which greatly stretched our budget for, while the community had plentiful accommodation, it came at resort prices!

The PAC's financial contribution to the TPDP was the most public manifestation of their commitment but individual parents contributed in other ways. Nick noted,

> The parents gave us financial support but the parents also gave us moral support in the community because demands from the parents for us to do this that and the other thing, have either dropped away completely or they are so easy to deflect that you cannot help but believe that there is support in the community, someone saying, "No, no they are doing something this year." (N. F., DB940316, p. 20).

A Ministry of Education grant. The Ministry of Education established a fund of $130,000 in response to the findings of 1991 Provincial Assessment of Science; the vice-principal applied for a grant intended to support "innovative school or classroom-based projects which contribute to improvements in teaching and learning in the areas of science, mathematics or technology" in elementary schools (Classroom Discovery Grants Application, Ministry of Education, Learning Resources Branch, 1993). A letter dated December 10, 1993 informed Steve that his application for a Classroom Discovery Grant had been approved for the full requested amount of $4270. Funds could be used for teacher release time but not for capital items or learning resource materials because districts were given money for those items through the fiscal framework. Some of these funds were used to hire teachers-on-call so that teachers might have release time on Thursdays for planning or consultation with Bob, Steve or me, or with one another (DB940119).

University of British Columbia funds. In January, 1994, Bob applied for and received a $3000 grant from the Rex Boughton fund of the Department of Mathematics and Science Education, a fund established by a former chairman of the department, to promote science education (DB940105). These funds also paid for teachers-on-call (DB940119). Bob's
travel and accommodation expenses were paid for by UBC's Office of Distance Education as a result of offering a credit course at the school.

Other supportive agencies and individuals. Three additional agencies and a number of individuals supported the TPDP. In October, 1993 Bob and I presented a full-day Project WILD workshop to teachers at no cost to them; each teacher received a thick manual of activities ready for use with their children. In March, 1994 a representative of BC Hydro presented educational materials at a half-day professional development day workshop, leaving teachers with resource materials. In April, 1994 we used workshop time, expanded to 3 hours through teacher consensus, for an APASE (the Association for the Promotion and Advancement of Science Education) workshop on structures presented by a visitor from Vancouver. She, too, left teachers with classroom resource materials. Throughout the year, a number of authors of science-related books spoke to classes of children as part of the teacher-librarian's meet-an-author program. On one occasion, one of these authors presented her work to our group at a workshop (CL940202). Similarly, a number of scientists visited the school during the year to talk with classes; in one week in January, 1994, eight scientists made presentations at the school (School Newsletter, Feb. 8, 1994). In all of these instances, there might have been a slight cost to the school such as providing the speakers with lunch, but speakers donated their time to our common purpose of enhancing the children's science education. Their contributions were much appreciated.

A View from the Accreditation Process

In the year following the TPDP (1994-95), Mountainview Community School completed the accreditation process mandated by the Ministry of Education, a process in which strengths and weaknesses are identified in order to develop plans for the future. The reports give a snapshot of the organizational context of the TPDP, that is, the school, in the year immediately following the TPDP.
This two-step process included an internal review conducted by the school staff led by a four member team including two teachers, the principal and a parent, followed by an external review conducted by a five member team from elsewhere in the province, comprising two principals, two teachers and a parent. The teams assessed and commented on five dimensions of the school: Learning Experiences, Professional Attributes and Staff Development, Leadership/Administration, School Culture, and the School and its Community. In all cases the reports were positive, even glowing, and the accreditation process concluded that Mountainview was an excellent school, with ample and varied opportunities for student learning.

The internal team noted the high academic expectations and achievements of children, along with high expectations for student behavior, as strengths in the learning experiences (Mountainview Community School, 1995: Elementary School Accreditation, March 1995: Internal Report). The external team validated most findings, perceptions and conclusions of the internal report. The external report noted the "enthusiasm for learning that permeates the school" (p. 7) and referred to the "evident high satisfaction of parents and the quality of learning experiences offered by the school" (p. 14). It noted the "caring, sense of quality and standards of excellence . . . abundantly displayed" (p. 3). The team members expressed their appreciation for the "gracious hospitality, open dialogue and extensive cooperation of the staff. The whole school community -- students, staff and parents -- were exceptionally friendly" (p. 3). They mentioned the enthusiasm, good humor, candor, assistance, high level of professionalism and support of the staff, concluding that Mountainview Community School was "an excellent school . . . [and] an exceptionally fine place to work and learn" (p. 3).

The external team concluded with the following:

Mountainview Community School is undoubtedly an excellent school of which all its stakeholders -- students, staff, parents and community -- can be very proud. The highlights of the school include:
1. an extremely professional and caring staff.

2. a strong administrative team.

3. courteous, confident and responsive children who obviously take pride in their school and their learning.

4. a very supportive and proud parent community.

5. an excellent working relationship with the broader community, especially with the municipality.

6. a commitment from the whole school to reflect on and improve the learning opportunities for each child in the school.

The external team considers it a privilege to have been involved with the school. We thank you for making this a rich, professional experience for us all. (Mountainview Community School, 1995: Elementary School Accreditation, March 1995: External Report, p. 37)
CHAPTER VI

OUTCOMES OF THE TPDP VIS-A-VIS THE SCHOOL OBJECTIVE FOR SCIENCE

In this chapter, I present my evaluation of the outcomes of the TPDP as they relate to the school objective by referring to comments made by staff during the TPDP and in the vice-principal's end-of-year survey, to comments made by parents, and to reports of the school accreditation process conducted in 1994-95, the year following the TPDP. In so doing, I answer my second research question, "How did the outcomes of the Teacher Professional Development Program relate to the achievement of the school's educational objective?"

The Objective for Science

The school objective for improvement in science instruction arose from concerns of school staff. They judged that, in general, not enough time was spent on science instruction at the school and that the existing science instruction was not student-centered and did not include enough hands-on activities.

The words used in the objective were relative: "more frequent, more active and more student-centered" (School Growth Plan, 1992). In talking with staff throughout the year I learned that, for individual teachers, these terms depended on existing practice. For instance, for Jacqueline, "more frequent" meant more than none at all (J. K., D940407); but for others, it meant one (H. S., LG940407), two (E. Y., DK940421), or three (M. N., LG940407) regularly scheduled science periods per week. "More active" meant using hands-on materials some of the time rather than just talking about science (H. S., LG940407) or teaching only content and relying on boardwork (L. M. & T. F., RT940504). "Student-centered" meant following the children's interests rather than an agenda pre-set by the teacher to teach the correct answer (J. N., SI940421). Hence, this school objective required substantial changes for some teachers and small changes for
others. However, all teachers embraced the notion that they would try to improve their own science teaching as they saw necessary, no matter where they began.

The school growth plan did not indicate how the desired improvement might be judged but did acknowledge a need for evaluation with a simple statement, "Evaluation: to be determined during planning stages" (School Growth Plan, 1992, p. 11). To my knowledge, a process for formal evaluation of achievement of the objective was not determined during the planning stages. No before and after measurements were taken that might help in evaluating whether or not the TPDP achieved the school objective. Nor could I make, on the basis of my bi-weekly visits to the school, any judgments about the frequency or quality of science lessons before, during and after the TPDP. However, I have looked at how the perceptions of the staff and parents changed over the course of the year by examining their comments in conversations and interviews and in responses to a survey soliciting their views.

Participant and parent comments. During the year, teachers, administrators and parents expressed their concerns about science instruction and their views about the TPDP in conversations and interviews. At the end of the year, Bob and I interviewed each teacher receiving course credit for participating in the TPDP for approximately an hour about their experiences. Teachers' comments must be evaluated in the context of a university course which was graded; it would have been remarkable if the teachers had been overtly critical. However, their comments were consistent with the commitment and enthusiasm I observed during their participation in the year's events and I think their remarks can be taken as stated. At the completion of the course, I invited all participants to spend an hour and a half with me to discuss the benefits and drawbacks of the TPDP. The comments of the teachers who took part in this roundtable session add a concluding dimension to teacher perceptions. I conclude from their comments that they were generally satisfied with the changes in science instruction at the school and attributed those changes to the TPDP.
End-of-year survey of teacher opinion. At the end of the school year, the vice-principal created and distributed a survey to all participants (excluding himself and the principal); seventeen surveys were completed by twelve classroom teachers, four non-registering teachers (the teacher-librarian and three learning assistance teachers), and one teaching assistant.

The survey form stated its purposes:

- to provide us all (school and UBC personnel) with information helpful in planning future professional development projects.
- to provide participants [with] an anonymous means of offering suggestions and expressing opinions. (1994, Mountainview Community School Science Project Participant Survey, p. 1)

The survey invited candid views not only of enthusiastic respondents, but also the least enthusiastic teachers, for it allowed participants to respond anonymously. Survey responses corroborate comments made by teachers at other times during the year. The survey responses were generally positive but did bring to light some criticisms of the TPDP.

TPDP Outcomes and the School Objective: What Teachers Said

During interviews, teachers talked about three things. They talked about their participation in the TPDP and its effect on their science teaching, related directly to the school objective of making science instruction more frequent, more active, and more student-centered. Second, they talked about how their attitudes towards science and towards teaching science changed during the year. Third, they spoke of the value of the TPDP's approach to staff development. The vice-principal's end-of-year survey included several questions designed to explore these same areas. In the following pages I present teachers' responses based first, on the interview data and second, on survey data.

Teachers stated that their classroom teaching changed as a result of the TPDP, some by teaching more science, some by clearly identifying what they were already teaching as
"science", some by shifting from an emphasis on content to including hands-on activities. Hans said,

There have been many good ideas presented, good discussions that have sparked my motivation and made me want to get more involved with hands-on/exploratory. I felt that I needed to change and the course has furthered that need plus given me some change already. It has contributed to change. (H. S., LG940407, p. 11)

**More frequent science instruction.** At the beginning of the year, Nick and Steve stated that science had not been a priority at the school prior to the TPDP. While they stopped short of saying that very little science had been taking place in classrooms, they seemed sure that no one on staff, except Steve, saw himself or herself as a strong science teacher (PL930917).

As I got to know the teachers I discovered that Lily had a lively science program, including outdoor education activities, in place; Elizabeth had involved her children the previous year in a gardening project in which they turned a plot of land in front of the school into a butterfly garden; and David had begun using Innovations materials prior to the TPDP. However, these activities were rather low-key and represented only a few of the classroom teachers.

Several other classroom teachers commented that the TPDP forced them to keep focused on science when planning their year’s program. Jacqueline ruefully admitted that previously she had taught science not at all (D940407); Marion said that she had taught science only when she felt that she’d better teach at least a token amount of science, and that attending the regular workshops meant that she couldn't put science off until next week or next year (JL940421). Hans noted that he met his personal goal of leading one science activity a week with his primary class, implying that he had not been doing so previously (LG940407). Elizabeth said that the course motivated her to keep her mind focused on science, commenting,
I ended up having two science periods a week . . . . Not trying to integrate it into a language arts lesson, but actually saying, "This is going to be science", because then it made me sit in my planning time and actually think about what I was going to do rather than just to leave it for, by happenstance, whether it goes or not. (E. Y., DK940421, p. 13)

Marjolaine described how she scheduled three 40 minute science periods a week for most of the year and covered a full range of science topics; she attributed this development to the confidence she developed during the course (LG940407).

Tilly commented that the course helped her realize that she could pull more science into her integrated language arts themes, a curricular area with which she was comfortable; during the TPDP she focused on looking for more science books for use in her classroom (SA940421). Similarly, Frances, the teacher-librarian, felt that her participation in the TPDP forced her to attend to science; she said that this opened a whole new area for her to focus on in library resources. The TPDP's budget provided her with funds to order science books and videos as well as to buy professional books which she felt she could not have otherwise done (EJ940421).

Two questions on the end-of-year survey asked teachers about the amount of science instruction their classes received during the year. Teachers' comments indicate that the workshops gave them ideas to try with children and the confidence to teach science units and helped them make science more of a priority than in the past; one teacher noted that s/he covered more mini-units between major units due to high student interest. The teaching assistant used her science knowledge to develop individual programs for the special needs children with whom she worked.

More active, student-centered science instruction. Hands-on activities were the heart of our workshops. We encouraged teachers to introduce interesting demonstrations in their classrooms and then to leave children free to explore possibilities arising from the activities. We suggested that children be given open-ended challenges and problems to solve, and to design investigations that would increase their understandings of the science concepts under study.
Teachers' interview comments indicate that they did more hands-on science with their children during the year than previously, and that this change was attributable to their participation in the workshops. Leanne explained that her children were still learning content but not as much as previously. At the end of the year, she described, "I've been teaching 8 years and this year I've taught more science than any year before. Yes, I taught science before but, no, I didn't teach hands-on." I asked, "What did you teach before?" and she replied, "Content." (L. M., RT940504, p. 6). Earlier in the year, she had contrasted her hands-on emphasis with what she referred to as an abstract, intellectual, academic approach to science. "I mean, they are not learning facts, they are not memorizing content, not studying a paragraph on such and such and learning how it works. There is a difference" (L. M., D940407, p. 16). Instead, they were exploring possibilities in hands-on activities, thinking creatively and discussing their findings with the class afterwards. Leanne felt positive about this change.

Two primary teachers, Jill and Tilly, spoke about the changes in their classrooms, describing how they became more accepting of noise and apparent chaos inherent in hands-on activities and learned not to frame this as a loss of control (J. N., SA940421 & SI940421, and T. D., SI940421). This was particularly important for Tilly, for she had a large class which included a number of children with behavior problems; she said that she became more confident about teaching science under these conditions. She learned not to worry so much about what the product of the lesson looked like, but to focus on the process of the investigation (SI940421). Jill said that she directed her children less this year towards what she called a "correct answer"; instead she placed more emphasis on children designing their own experiments. Jill judged this approach to be more beneficial to them (SI940421). Trixie also mentioned this shift of attention to process rather than product (SI940421). Elizabeth noted that, while she had taught science before, she had generally done little projects in biology; the course helped her broaden her program beyond biological science and deepen it, particularly with reference to assessment and
evaluation (DK940421). Leanne said that she was really happy with her year and felt it was "definitely the best year for me teaching science that I have ever had, because of the course and the direct help, the time, the course being here" (L. M., D940407, p. 13).

For Kelly, the availability of funds to purchase materials for science made a difference; previously she felt she had to scrounge or do without (LJ940421). During the TPDP, teachers could make purchases and be reimbursed, and use the materials and equipment bought by the staff to support the program.

Two questions on the end-of-year survey asked about hands-on science. While no question asked specifically about student-centered science, teacher comments relate to that aspect of the school's science objective. One teacher commented, "The approach I had to this changed -- much more exploration time given." Again, a teacher said that the activities introduced in class helped give him/her confidence to try more hands-on activities with children; for one teacher, however, the amount of materials needed for a large class were a problem. The teaching assistant commented that the TPDP had a large impact on the time her special needs children had spent doing direct hands-on science.

What Teachers Said About Related TPDP Outcomes

Teacher comments during interviews and their responses to other survey questions reveal TPDP outcomes that contributed to meeting the three criteria set out in the school objective for science.

Changes in Attitudes Towards Science

While several teachers mentioned that they enjoyed science prior to the TPDP (K. D., LJ940421; K. M, D. T., J. N., SI940421; M. Y., JL940421), others spoke about how their attitudes towards science changed positively due to the TPDP. Trixie said that she met a personal goal set at the beginning of the year, "to find a new way of looking at science and not be afraid of it, and to feel more comfortable and relaxed going in and teaching science"
Children's excitement. Teachers commented on their children's attitudes towards science in a tone of surprise and delight, implying that they had not expected their children to respond so enthusiastically. Children were "excited" (E. Y., DK940421, p. 4), "having a good time" (M. N., LG940407, p. 2) and "really enthusiastic about what we do in the class" (J. K., D940407, p. 3). Hans noticed an increased awareness of science evidenced by little experiments and demonstrations that children brought from home (LG940407); similarly, Leanne described a project about weather that a student had worked on at home and brought to class to share (KL940407). Elizabeth noticed that children were no longer grabbing at materials but shared and cooperated when using science equipment (DK940421). Teachers attributed these changes to the course. A teacher commented on the survey, "They love hands-on experiments."

Fun professional development. Comments responding to a survey question regarding the inclusion of hands-on activities in the workshops elicited comments that reveal the enjoyment of the teachers themselves as they engaged with the materials: "The best part of the course!" "Loved it!" "Fun, too!"

This notion of science being fun was important to teachers; I was not alone in observing teachers having fun at workshops. As Frances and Teresa recalled at the end of the year, "There was always food there, we laughed a lot, everybody was fairly relaxed" and "When you look at pictures [taken by Nick] we look like we're having a good time" (F. C. & T. F., RT940504, p. 10). Some teachers said that, as a result of participating in hands-on activities, they learned to enjoy science and not only taught science more often but also had a good time doing it. Marion commented that previously she had taught science only because she had to and only if she had time (JL940421), but she found now
that she liked science better herself and made her lessons more fun, so her children had more fun. Jacqueline commented,

My attitude has changed since the beginning, since I didn't want anything to do with science at the beginning! (laughter) ... Now that I have done it and it has been fun for me, it tells me it can be fun, and we just do it. (J. K., D940407, p. 2)

Bonnie commented that the course challenged her to enjoy science herself. Previously she avoided science and traded off teaching it with other teachers; the course forced her to try teaching science and she was surprised to find she liked it (SA940421). Jill said that she enjoyed science before the TPDP, but had not particularly enjoyed teaching it. Once she allowed her lessons to become more exploratory and less directed at the children's getting to "a correct answer", the children became more excited so she became more excited (J. N., SI940421, p. 13). Elizabeth also mentioned the contagiousness of the children's excitement (DK940421). These comments suggest a connection between these teachers' personal enjoyment of science and their science teaching.

Changes in Attitudes Towards Teaching Science

Two survey questions probed the connection between the TPDP and the teachers' enjoyment of teaching science at the end of the course. One teacher commented that she already enjoyed teaching science, another that the enjoyment level was the same as before the TPDP. For the teacher of a split class, science had become the easiest and most interesting subject to teach and prepare. This is an encouraging comment, for teachers of split classes often feel burdened with the responsibility for teaching a double curriculum. One teacher said, "It has become a favorite for me. I'm excited about teaching in this area" and another, "Messing about' in science teaching (with support) is completely responsible for my growth in enjoyment of science teaching." This comment refers to an article by David Hawkins (1965) that we had shared with teachers, "Messing About in Science".

In conversations, some teachers talked about the connection between their personal enjoyment of science and their science teaching. Teachers commented that the kids had "a
great year" (E. Y., DK940421, p. 15), that teaching science became "exciting" and "exhilarating" (K. P., JL940421, p. 7) and that classroom science became "fun" (T. N., KS940421, p. 21; K. P., JL940421, p. 7; E. Y., DK940421, p. 15). Marjolaine described how she became more organized and more confident about teaching science and so did more science things (LG940407). Marion stated that she became more of a risk taker (JL940421; also T. D., SA940421); this change was gradual for her and the year-long project allowed her to take little steps and feel successful and secure as she changed. I find this connection heartening for it seems to me that teachers are more likely to teach curricular areas if they not only enjoy the subject matter but also enjoy sharing it with their children.

**Teacher confidence and proficiency.** Four survey questions inquired about two teacher attributes that might contribute to the likelihood of teachers teaching science, confidence and proficiency. Teachers' comments imply that teachers' confidence and skills grew but that they felt there was still room for growth, for now, at the end of the TPDP, only a few teachers said they felt greatly confident and proficient. Teachers expressed the need for continued support and encouragement and advice and a sounding board for ideas, as well as more strategies to present hands-on experiences to their classes.

**A roundtable discussion.** At the end of the year, six teachers took part in a roundtable discussion, including five who had participated for credit. Each of these teachers was an enthusiastic and supportive participant in the TPDP; the fact that they chose to give an hour to discussing the course with me indicates their commitment. The teachers presented me with a lovely framed photograph of a river valley near the school grounds, with the thanks of the staff for my contributions to the TPDP. After their laudatory comments and my thanks, I asked rather bluntly what difficulties they could identify about the year. This opened a flood of comments about difficulties inherent in previous professional development activities in which they had participated, such as the ineffectiveness of one-shot workshops and the impossibility of taking evening courses at a distant university. As
they spoke, individual teachers' remarks were often met with a chorus of *yes! and that's right!* When I asked them to tell me of any difficulties they identified in this unusual course, they replied that they couldn't think of a single one (RT940504).

**TPDP Outcomes and the School Objective: What Administrators Said**

When I reviewed audio taped conversations with administrators, three criteria emerged as being important to them in assessing the outcomes of the TPDP: the teachers' enthusiasm for the science presented in the workshops, the amount and kind of science being taught in classrooms, and feedback from parents.

**Science in Workshops**

One of the goals of the workshops was to intrigue teachers with the activities and so get them hooked on the fun implicit in science, for the planning team believed and hoped that teachers' enthusiasm for science would diffuse into their classroom practice. After only the third workshop, Nick expressed satisfaction with the way the course was going, saying that he was pleased and overjoyed at the teachers' enthusiasm.

> If they can convey that enthusiasm into their classrooms and if we can validate that, if we can make them feel that that is science that's valid, that's what it's all about. Then what you've done is you've institutionalized . . . science . . . It's institutionalized, it will be here long as those people are. (N. F., DB931103, p. 23)

As the year went on, Nick and Steve noticed the increasing intensity of the teachers' involvement in the workshops. In a debriefing conversation in March, 1994, both administrators commented on a 40 minute discussion in the workshop around the issue of evaluating hands-on science, and observed that they were pleased with the professional interest evident in teacher's involvement.

> If we had listed specific goals for this project, we probably wouldn't have written that one of the goals was to have people participate more actively in their professional development sessions . . . I would have probably written a goal that I would have wanted them to participate more actively in . . . science instruction in the classroom (S. R., DB940316, p. 12)
After the third workshop, Nick talked about what he referred to as "spontaneous science activity" (N. F., DB931103, p. 27) in the school in which teachers were beginning to get together to do bits of science together. Trixie and Nancy worked together to present the egg-in-the-bottle demonstration to a class; their enthusiasm was reassuring.

After the third workshop, Steve sensed that teachers were starting to try things out in their classrooms that they didn't really believe would work (DB931103) and that teachers were encouraged by their little successes. They were still far from self sufficient, however.

Science in Classrooms

Shortly after Christmas, Steve expressed his concern in a debriefing meeting that, despite teachers' excitement with little hands-on activities, there was not enough sustained science teaching and in-depth explorations going on in classrooms.

We're a third, between a third and half way through the course and I actually can't assure anybody that there's one hell of a lot of science going on in those classrooms . . . . Now it may be 'cause I'm just not getting out there and looking for it. But it hasn't just, you know. Walking up and down the halls and going into classrooms, I go into five or six different classrooms every week . . . . It's not hanging from the ceilings and the walls and out on the desks and out on the counters . . . . (S. R., DB940105, p. 15)

By the following workshop his view changed, for he went looking for evidence that science was being taught in the school. "I started paying more attention to what was going on in the classes [classrooms] and I was less worried. I saw more science going on suddenly" (S. R., DB940119, p. 6). Teachers were, no doubt, aware that he was visiting classrooms regularly, looking for science, and quite possibly increased the amount of science they were teaching. In any case, Steve's new perception, coupled with his observation of teachers' intense involvement with unit planning reassured him greatly and gave him the sense that the course had reached a watershed in affecting classroom practice (DB940119).

The planning session followed the vice-principal's statement to teachers that they must choose a science unit and make a commitment to teach it for a number of weeks. Teachers
appreciated the planning time and, during the next workshop (CL940202), spoke of what they were doing: Elizabeth was working on structures; Bonnie and Kelly were presenting a multi-media science unit, *The Voyage of the Mimi* (1985) which was the children's favorite time of the day. After the workshop, Steve described other science units in the school: Lily and Hans combined their classes for a unit on rolling things, Marion was teaching a unit on flight, Leanne and Teresa's classes were working on simple machines, Trixie had set up a salmon hatching tank in her room, and Craig's class was working on structures (DB940202). By the following visit, Steve's sense was that almost every class was involved in some unit (CL940211).

Nick and Steve commented on the general expectation among teachers that science should be going on everywhere in the school. Steve was cautious, however, about claiming 100% commitment and participation by teachers in classrooms merely on the basis of their keen workshop participation.

What I'm hoping is that the degree of participation in the session reflects to some extent the degree of commitment and participation by teachers in the classrooms. I don't know that that's the case; I know it's the case in some classrooms; that's almost evident in some of the conversations that were taking place, But I don't know to what extent that's the case. I guess that's what I'm saying. And I don't know to what extent it's reasonable to expect that it be the case. Like 100%? No, I don't think that's reasonable. (S. R., DB940316 p. 12)

A Letter of Thanks

In April, 1994 Nick sent a letter to the Dean of Education at the University of British Columbia. In it, he expressed the gratitude of staff, children and parents at Mountainview Community School to Bob, to me, and to the Distance Education staff for making the TPDP possible, a program resulting in "vastly improved learning opportunities for children". He described the TPDP as a "professional development experience of remarkable effectiveness" by helping to develop the instructional knowledge, skills and attitudes of staff. He remarked positively on the approach of addressing the particular needs and interests of the school community and the individual needs of the staff. He
noted that children now received many more hours per month of science instruction than prior to the course, spending a large part of science class doing hands-on science activities. He noted the success of children at the school, district and regional science fairs and mentioned the Parent Advisory Council's letter congratulating the staff on the school's fine science program. He described that the PAC had nominated the administrators for a national science award for their contribution to the program. He mentioned that news of the success of the TPDP had resulted in other school staffs' requesting presentations to help them upgrade their science programs (AR940422).

The administrators' observations concerning teacher enthusiasm were confirmed by an invited workshop facilitator. Late in the year, we hosted an APASE (Association for the Promotion and Advancement of Science Education) engineering workshop on building structures; after the workshop, the facilitator remarked on the enthusiasm and apparent commitment of the staff to science. She commented to me that the staff seemed responsive and involved in the workshop activities. She expressed surprise that, during the question and answer period, the teachers did not throw up any barriers as to why they couldn't use the APASE materials in their classrooms; such protests were common in other workshops she had given. Instead, she sensed that teachers just knew it was do-able (FN940420).

This visitor's comments confirmed what I had noticed; when Steve asked for help in setting up for the APASE workshop, all 12 tasks on the sign-up sheet were taken on by teachers. I noted that teachers entered looking tired yet participated enthusiastically with much laughter. At the end of the day, two teachers commented to me how proud they were with their participation in the building of the structures (FN940420).

TPDP Outcomes and the School Objective: What Parents Said

In September, 1993 the administrators spoke to Bob and me about the importance of parents' views in evaluating the success of the TPDP. They said the parents were, as a group, interested in and concerned about their children's education and, for the most part,
well enough educated to know that science isn't found simply in a textbook, but is a way of thinking and doing. With Mountainview being the only elementary school in the community, parents with high expectations had little choice in where their children attended school and many were not hesitant to express their concerns to the school staff. An indicator of success would be positive feedback from parents. Nick predicted that there would be compliments from parents, inspiring teachers to further efforts.

Important feedback will come from the parents who almost immediately will see or hear from their children that sciencing is going on in the classrooms. . . . They will be very complimentary towards the teachers, because they are here, very complimentary when there is something to compliment. When the teachers hear the compliments starting to come in, their enthusiasm for the program [will increase]. . . . and there will be more sciencing going on, and there will be more compliments and so it will go. (N. F., PL930917, p. 6)

Parents became aware of the science teaching in the school associated with the TPDP as soon as teachers began to try workshop activities with their children. At the end of the year, Nick commented to me that he had what he called a clear indication that the TPDP was meeting the school objective; parents were telling him that their kids were coming home and talking about how much they liked science (FN940504).

Teachers also described how parents expressed satisfaction with the changes in their children's science instruction, frequently mentioning comments parents made when children took home little science activities they had done at school (B. F., SA940421). As Teresa told me in February, 1994,

My kids go home now so excited about science and they talk about things they're learning. For Grade 6/7 that's pretty good. And I send them home science experiments to do with parents, so the parents are going, "Oh, they are doing science now". (T. F., S940203, p. 4)

Jill said something similar.

I find quite often the kids, after they've done an experiment in class, they'll extend it at home. Their parents will catch me in the hall and say, "Little Johnny was trying out dah, dah, dah at home". And they kind of extend it, then they have more time to do it and they interact with the parent as well. (J. N., SI940421, p. 14)
Elizabeth commented, "Parents are excited. The parents love the things . . . . [They ask,] 'So what are you doing next?'" (E. Y., DK940421, p. 11).

Early in the TPDP, at our second workshop, Teresa talked about an activity she did on surface tension; she said that most of her children did the activity at home with their parents and added, "I've had nothing but really positive feedback because parents see that we're doing science in class" (T. F., SM931020, p. 3). When I asked her midway in the TPDP if she was getting any feedback from parents about her science program, she replied, "Oh, yeah, no one is complaining", and "Parents' knowing what's going on in the classroom through their kids is my most important feedback" (T. F., S940203, p. 10). She confirmed that most of the children were taking their enthusiasm for science home.

I find it interesting that Teresa expressed approval from parents as a lack of complaints. "What I've learned over the years is you can't expect a lot of positive things from parents. If something is really bothering them they will come and tell you immediately and you'll know" (T. F., S940203, p. 10). At another time, Marion said something similar. "What I find is that no matter what I do, someone will criticize; that's sort of a given" (M. Y., JL940421, p. 18).

Some mixed reactions. While parents were aware of changes in the science instruction, not all reacted with enthusiasm. Even by the end of the TPDP, some teachers felt that they still hadn't completely satisfied parents' concerns, in part because of a discrepancy between what parents defined as science and the approach to learning promoted in the TPDP. I asked Tilly did she think the parents were getting a different message (from the previous year) about the amount of science she was doing and she replied,

I think generally the parents still think experiments are science. Like the chemistry type kitchen experiment is science. But we always put it down on our monthly outline. I just put science and what we're doing in science so that we change that way of thinking of people. (T. D., SI940421, p. 14)

For Marion, this confusion about what is science resulted in what she called mixed reviews from parents.
I've had some parents that are very positive and they say, "My kid seems to really be enjoying science and you're doing some interesting things", and then I've had some others who'd say, "My child's been studying flight but he can't tell me how an airplane flies." Well he probably can't [laughter]. But a lot of my parents are content driven. (M. Y., JL940421, p. 18)

This tension between science as content oriented with knowledge transmitted from expert to novice, and science as understandings constructed through experience, was the subject of many of our workshop discussions.

**Increased Science Awareness**

**Promoting science to parents.** Parents became aware of the teachers' efforts to improve science instruction at the school from their children's excitement, and from deliberate promotion by the staff. The learning-by-doing approach provided tangible evidence: school bulletin boards displayed children's work and accomplishments, clearly visible to parents and other visitors (PH940316).

School staff also informed parents directly of the science teaching in the school by means of the regular school and classroom newsletters (L. M. & T. F., RT940504 and T. D., SI940421) and through bulletin board displays throughout the school which parents found interesting (L. N., RT940504). The staff's public relations effort during the year made parents more aware of the good science teaching already happening at the school, and shifted parents' opinions from uninformed to positive. As teachers commented to me at the end of the TPDP, "I think the parents were quite unhappy with science education and were under the impression that we weren't teaching science; [that's why] we decided to do it for the school growth plan . . . . Some of us were teaching science but we weren't getting the message across . . . . Some people did science one term, socials another, I think that's where that idea came from that we weren't doing any science" (RT940504, p. 6).

Nick worked hard to bring the TPDP to the attention of parents at PAC meetings once the program got underway.
At the PAC meeting [last night] I got up and ... I thanked them for their moral and financial support of this project and told them it's going like a hot damn. And I said, "I'm hoping that you parents are aware of the increased science activity that's going on in our classes." And all over the room I heard, "Yeah we are, yeah we are, we're really happy." Now what's important is to take that to the staff because ... the PAC are really, really aware of what's going on, of the increased activity and they're happy. And maybe the key word ... is activity. (N. F., DB931103, p. 23)

In March, 1994, the secretary of the Parent Advisory Council wrote a letter to the staff congratulating them on the science fair results. Teresa and Leanne required their children to participate in the school science fair; student entries emphasized hands-on activities. Student submissions to the district fair won seven out of eight awards at the Grade 6/7 level, and three school projects were nominated to go on to the regional science fair held in Vancouver. The PAC letter commented on the caliber of the displays in the school gym and stated, "Obviously the extra science classes you are all a part of with UBC and the excellence of our teaching staff is shining through!" (AR940308). This science fair triumph was proclaimed in an exuberant bulletin board display in the school (PH940316) and announced in the local community newspaper (AR940303).

Whereas early in the TPDP Nick stated that he thought the PAC to be representative of parental views in expressing concern and criticism of the school's science program (DB931103), later he viewed comments made at PAC meetings as not really representative of the parent body. In a debriefing session, he told the planning team of his worry that, given more power, the PAC could become the "tyranny of the minority" (N. F., DB940302, p. 2) for by then he believed that most of the clientele (his word) were happy, maybe unhappy with circumstances but not with the school.

I infer from these parent reactions that parents were generally satisfied once some science, any science, was happening in classrooms and that some were thrilled with their children's new-found excitement about science.
My Perceptions of Parent Satisfaction

I spoke only briefly and incidentally with a few parents about the TPDP. Two encounters come to mind. On one occasion, a mother who was also a teacher-on-call and school volunteer told me her daughter talked about science at home. This woman had heard that the teachers really enjoyed the science workshops and told me that teachers at another school in the district were "really jealous" and she just knew they would love the TPDP (OB940302). On another occasion, I noticed a woman about my age standing outside the library talking quietly with two older adults; I learned that this was a mother with two grandparents. I introduced myself as one of the instructors who came from UBC to teach the science workshops. The woman said, "These workshops are just wonderful" (OB940316, p. 6). I asked how she knew, and she said her kids talked about it at home, how much science they do and how much they liked it. She was quick to say that she didn't mean to imply that the science last year wasn't any good, but that there seemed to be so much more this year.

Such satisfied views are supported by the results of a survey of parent opinion conducted in the Fall following the TPDP and are discussed at the end of this chapter in a section detailing the 1994-95 school accreditation process.

Criticism a benefit. This discussion gives an impression of a number of influential and demanding parents. But parental concern, while sometimes disheartening to teachers who felt they were working as hard as they could and somewhat overwhelmed by the demands of teaching, had a positive influence on the TPDP. This feeling of having to be responsive to parents' opinions acted as a nudge to initiate the TPDP; moreover, parental attention to what was happening in classrooms proved to be a strong encouragement to teachers during the TPDP.
Science Instruction at Mountainview: The Accreditation Report

A final view of science instruction at Mountainview Community School at the conclusion of the TPDP is found in the 1994-95 accreditation report. While accreditation results alone cannot argue that the TPDP helped the staff reach their objective of making science more frequent, more active and more student-centered, the accreditation report deemed science instruction to be satisfactory, presenting evidence of a hands-on approach.

**Learning and science at the school.** In responding to the accreditation statement, "Students demonstrate success in terms of knowledge, skills and attitudes in science", the internal team cited evidence found in school actions and programs:

- Science curriculum taught K - 7
- Science themes in primary grades
- Hands-on science throughout the school
- Sequence of science skills taught
- Students learn how to use science equipment
- Science Fair popular with students, staff and parents (Mountainview Community School, 1995: Elementary School Accreditation, March 1995: Internal Report, Section One, No. 9)

The report concluded that staff members were "satisfied" with student success in science.

Data collected by the internal team included a survey of parent opinion taken in early Fall of 1994. One hundred eighty-five parents took part in the survey. 15% of respondents strongly agreed with the statement, "The school is doing a good job of teaching science to my child"; 59% agreed, 23% had no opinion, 2% disagreed, and less than 1% strongly disagreed.

The external team agreed with the internal team's assessment of student success in science and commended the staff for the development of the science program, encouraging them to maintain the hands-on approach. The external report also mentioned
CHAPTER VII

SUMMARY OF FINDINGS, DISCUSSION OF ISSUES, AND AREAS FOR FURTHER STUDY

In this chapter, I first revisit the research questions and summarize the findings of the study. Next, I discuss issues arising from two features of the Teacher Professional Development Program (TPDP), whole staff participation and school-university collaboration. I found these two features particularly interesting for they were both essential to the TPDP's success and troublesome to its implementation; their discussion might be of interest to educators responsible for planning staff development. I conclude by proposing areas for further research.

Summary of Findings: Instructional Improvement Through Teacher Inservice

Elementary school science instruction in many Canadian classrooms needs improvement, as indicated in two large scale studies of science education practices (Science Council of Canada, 1984; Bateson, Erickson, Gaskell & Wideen, 1991). This need can be addressed through science inservice for classroom teachers. However, the above two studies, plus a more recent one by the author (Brooks, 1994a), show that teachers are dissatisfied with the quality of inservice available to them.

The "one-shot" workshop presented on an occasional basis at the school, district, or provincial level is the most common format for elementary science teacher inservice in British Columbia. My conclusion from personal experience as both an inservice participant and inservice provider is that, while the one-shot workshop can be effective in familiarizing teachers with curriculum or teacher resources, it contributes little to significant changes in classroom teaching.

In the process of developing their 3 year school growth plan, the Mountainview Community School staff identified improved science instruction as an objective and
developed the Teacher Professional Development Program (TPDP) as a way to achieve their goal. The TPDP, different from the science inservice previously experienced by teachers, was "extensive and extended" (School Growth Plan, p. 11). The TPDP:

- extended over a school year.
- provided the only school-based inservice for that school year.
- included teacher workshops, with intensive hands-on experience with materials.
- included follow-up support in the classroom.
- included all teaching staff and both administrators.
- included university personnel.

The Research Questions

The TPDP was designed to enable the teachers to meet their objective of making science instruction more frequent, more active, and more student-centered in all classes in the school. This case study addressed two research questions:

1. What attributes of the Teacher Professional Development Program supported the school's "objective" for improved science instruction?
2. How did the outcomes of the Teacher Professional Development Program relate to the achievement of the school's educational objective?

TPDP attributes. The first research question focused on program attributes which supported the school's objective for improved science instruction. For the purpose of this summary, I have clustered these attributes in three groups: the teachers and their context, the planning process, and the organizational context, that is, the school.

The Teachers and Their Context

The TPDP:

- was designed to address a compelling need.
- developed on the foundation of a well thought out school goal.
- involved teachers who were motivated to participate.
- involved staff interested in a collaborative planning process.
The Planning Process

The TPDP:
- acknowledged individual teachers' differences and responded to individual teachers' needs.
- incorporated open-ended, flexible planning.
- blended models of staff development in a comprehensive program.

The Organizational Context

The TPDP:
- developed in a positive organizational climate.
- used a team approach to leadership.
- allocated adequate resources to the endeavor.

TPDP outcomes. The second research question focused on how the outcomes of the TPDP supported the achievement of the school's educational objective for science. I have arranged these outcomes in two groups: outcomes that relate directly to the school's objective, and those that relate indirectly to the objective.

Outcomes Directly Related to the Objective

Science instruction became:
- more frequent.
- more active.
- more student-centered.

Outcomes Indirectly Related to the Objective

An increase was noted in:
- teacher confidence concerning teaching science.
- staff collegiality.
- effectiveness of communication with parents concerning the science program.

Each of these attributes and outcomes is discussed in greater detail below.
The Teachers and Their Context

A compelling need and an existing goal. Prior to the design of the TPDP, school staff identified a compelling need to improve science instruction at the school. The administrators recognized that school science, as described in the provincial curriculum, was not taught on a school-wide basis; individual teachers recognized that they were not teaching school science as they wished; and parents were dissatisfied with the quality of science instruction at the school.

The TPDP developed on the foundation of an existing, well thought out goal defined by the participants, for the school district superintendent required staff to develop a 3 year school growth plan. This requirement prompted staff to write an educational objective for science. They defined a number of strategies to help them achieve their goal for science improvement including "extensive and extended staff development and training" (School Growth Plan, p. 11), which evolved into the TPDP.

Teacher motivation for participation. Teachers were individually motivated to participate in this whole-staff professional development effort. Some teachers felt uncomfortable teaching school science and appreciated the opportunity to improve their teaching. Others were already teaching school science but valued the chance to expand their repertoire of teaching strategies. A few participated initially in response to peer pressure or to avoid confrontation with the school administrators, but with one exception felt their extensive time commitment worthwhile. Some teachers viewed the TPDP as an opportunity to work with colleagues to address a school need and as a response to parent concerns. More than half the teachers were motivated in part by the offer of course credit for their participation. While the intensity of teacher participation in the TPDP varied, there was general agreement that workshops were fun, interesting, and a good opportunity to engage in collegial activities with other staff members and university personnel.

Staff interested in a collaborative planning process. The school growth plan specified "use of UBC personnel" (School Growth Plan, p. 11) and the staff invited a university
professor, Bob, and me to attend a staff meeting 6 months prior to the first workshop. At that meeting, all partners in the endeavor agreed to a collaborative planning process: Teachers stated their needs and what they would like included in workshops; Bob and I stated our commitment to assist the staff in any way we could; the school administrators, Nick and Steve, stated their intent to join us in forming a planning team to steer the TPDP in response to teachers' wishes.

Underlying beliefs. The situating of the TPDP at the school site was deliberate, for the vice-principal concluded from his prior inservice experiences that the school is the most effective unit of change. The TPDP embodied the beliefs that school staff are in the best position to identify their professional needs, and that teachers are motivated to participate in an improvement program when they see a connection between the program and their individually identified needs. Liveliness, energy, and relevance come from teachers' active participation in program design.

This approach to program design contrasts with traditional inservice designed by the inservice provider as a "one-size-fits-all" workshop for use with any number of people with a diverse set of needs; the control of the inservice experience rests with the presenter, and content is pre-determined. Typically, workshops on a variety of topics are offered at the district and provincial level and teachers choose those of interest. Occasionally, a school staff requests a workshop to meet a goal such as learning "some hands-on science activities"; the inservice provider arrives at the school with a pre-designed workshop. In this approach, presenters think they have made a contribution to teacher knowledge and improved practice, and teachers are satisfied if they leave with one good idea.

Program Planning

Responsiveness to individual teachers' differences and needs. The planning team recognized the diversity among teachers in terms of science background, prior experience teaching school science, confidence level, willingness to take risks, and learning styles, and worked with teachers as individuals during and outside of workshops as needed. We
recognized that teachers must deal with the constraints and demands of teaching and tried to use teachers' time effectively; we scheduled workshops to fit into the school year, avoiding busy times such as report card times. The planning team began the TPDP with an open agenda and maintained flexible planning to respond to participants' needs and interests as they changed during the school year; we engaged in a cycle of planning, presenting, and debriefing each workshop, and discussed what occurred in classrooms between workshops.

Blended models of staff development. In responding to individual differences and changing needs, the planning team moved across Sparks and Loucks-Horsley's (1990) five models of staff development. The TPDP's comprehensive approach to staff development included: a teacher professional development program designed as one part of a school-improvement process; workshops combining training teachers in the use of science materials and instructional resources with inquiry into issues of practice; individually guided staff development projects defined by individual teachers to help them advance their learning; and follow-up classroom support at the request of teachers which included observation of teachers teaching followed by reflective discussion.

Underlying beliefs. The TPDP embodied that belief that there is no "typical" teacher nor a single "right" way to teach. Teachers are individuals with individual needs and learning styles, and their instructional programs reflect who they are. Individuals respond differently to various models of staff development, and a professional development program is most effective when it takes individual differences into account and acknowledges that teachers' needs change over time. Program planners are facilitators of teacher learning, and work with teachers to help them reach their goals. Learning is an ongoing process and occurs in the "doing", so teacher knowledge about teaching develops in the act of teaching. Change takes time.

This approach to planning contrasts with that used for traditional inservice presented by "experts" for "teachers" considered as a group rather than as individuals. A deficit
model is assumed: presenters train teachers in skills or identify important "knowledge" to be conveyed to teachers. Mastery of workshop material by all participants is sought, and the quality of the inservice is judged by product rather than by process. Typically, such inservice has clear, pre-determined goals and follows a single model of staff development, such as training.

The Organizational Context

The TPDP occurred within the organizational context of the school. The organizational climate, the leadership and support of school administrators and external consultants, and the allocation of adequate resources of funds, time and personnel to the effort influenced the TPDP’s effectiveness. Some attributes of the organizational context were already in place at the outset, such as a group of hard working teachers, a vice-principal willing to play a major role in planning and facilitating the program, and an involved and supportive principal. Others were deliberately planned, such as financial support for the TPDP.

Organizational climate. The teachers and administrators enjoyed a harmonious working relationship. The administrators acknowledged the importance of support for teaching and for teachers’ efforts to improve. Nick and Steve felt trusted by teachers, and teachers respected the administrators and looked to them for leadership.

The administrators identified a need for stronger collegial relationships among teachers and viewed the TPDP as a means to this end. The planning team worked to make workshops enjoyable, encouraged experimentation and risk-taking as teachers tried new approaches to teaching, and facilitated collaboration among teachers for lesson planning and teaching.

Team approach to leadership. Leadership for the TPDP was shared among the two school administrators and the university professor. Each respected and trusted the others, and both shared and divided responsibility for individual program components. Each planning team member was actively involved in the TPDP activities, with each playing the
role that made best use of individual strengths and interests. Nick and Steve provided
direction for change, and exerted strong and continuous pressure and support for
improvement. Steve acted as school-based facilitator and recommended Bob as a valued
outside resource person. Bob guided the change process and initiated the way of working
with teachers through his "negotiated course". While not a leader, I participated in the
TPDP as a member of the planning team and as a workshop facilitator.

**Allocation of adequate resources.** The need for adequate funding was acknowledged
early in the planning process and funds were deliberately sought. The TPDP had sufficient
resources to give the program a reasonable chance of success. The program was well-
supported financially through the school, the Parent Advisory Council (PAC), the British
Columbia Ministry of Education, and The University of British Columbia (UBC). This
financial support provided for acquisition of teacher and student text resources, science
materials and storage, workshop snacks, teacher release time, and expenses associated
with the involvement of university personnel.

Time was an important resource: time in each 2 hour workshop to explore science
activities, reflect on classroom experiences, discuss issues in teaching, and plan for the
next workshop; time after each workshop for the planning team to debrief and plan; and
time to visit teachers in classrooms and discuss the experience. Some of this time came at
a financial cost, such as hiring teachers-on-call to release teachers from classroom
responsibilities, but most of the time was "donated" by teachers, administrators, and
university personnel, and "borrowed" from other professional activities such as staff
meetings. Outside agencies provided personnel for workshops and individuals donated
their time to the effort. The school staff expected that change would take time and ensured
that the program would extend over an entire school year.

**Underlying beliefs.** The TPDP reflected the beliefs of the planning team concerning the
importance of the school context to individual teacher development. Teachers
implementing changes in classroom teaching need support: administrative support,
collegial support, and financial support. Positive interpersonal relationships greatly enhance the inservice program and facilitate program planning. A worthwhile endeavor deserves resources adequate for success: high quality facilitators, ample time, and adequate funding.

Traditional forms of inservice are short term and consider the organizational context, that is, the school, as separate from inservice. Teachers attend single science inservice workshops, often alone, then return to their schools to try to implement what they've learned. Isolated in their classrooms, lacking needed resources and materials, without the intense interest and support of their administrators, teachers often find it difficult to maintain their enthusiasm.

**TPDP Outcomes Directly Related to the School's Objective**

According to teachers, administrators, and parents, classroom science instruction became more frequent, more active, and more student-centered during the school year. Prior to the TPDP, science instruction was not a priority at the school and the majority of teachers were not teaching science on a regular basis. A few teachers taught science but their activities were low-key, and often textbook oriented and not "hands-on".

Staff attributed positive changes to the TPDP. The principal called the TPDP "professional development of remarkable effectiveness", noting "vastly improved learning opportunities for children" (N. F., AR940422). The findings of the accreditation process in the year following the TPDP included evidence of science curriculum taught K-7. The accreditation report judged science instruction to be satisfactory; the external team commended the staff for their development of the science program, encouraging them to maintain the hands-on approach (Mountainview Community School, 1995: *Elementary School Accreditation, March 1995*).

**TPDP Outcomes Indirectly Related to the School's Objective**

School staff identified other outcomes of the TPDP which contributed to meeting the three criteria included in the educational objective. Teachers' attitudes towards science and
towards teaching school science changed positively. Teachers who previously disliked science as a school subject looked forward to the fun of "doing science" with colleagues in each workshop. Teachers became more comfortable teaching science. When children responded enthusiastically to changes in science instruction, teachers were delighted. Parents became more aware of the school's science program through their children's excitement and expressed satisfaction to staff members with their children's school experiences. Staff members encouraged and supported one another and the collaborative climate of the school was enhanced as the teachers initiated short- and long-term teaming for planning and teaching science units.

Two distinguishing features of the TPDP were the participation of all staff members, and the offer of university course credit for teacher participation in the school improvement initiative. Comments made by TPDP participants show that, while these features enhanced the TPDP and contributed significantly to its outcomes, they were a source of confusion and discomfort for some participants. A discussion of issues that arose around these features might be of interest to educators responsible for planning school-based professional development initiatives. While this document relates to science, this discussion is relevant to other curriculum areas such as fine arts or physical education.

The Issue of Including All Staff Members

All staff members participated in the TPDP, not only the administrators and all classroom teachers, but also the teacher-librarian, three learning assistance teachers and, by her own choice, a teaching assistant, even though only the classroom teachers were responsible for science instruction. My conclusion from examining the TPDP is that the inclusion of all teaching staff became an issue due to two interconnected elements: first, confusion about the purposes of the TPDP, and second, the unstated self-exclusion by some staff members when the TPDP was designed for "all staff".
The explicit purpose of the TPDP was to help Mountainview teachers improve their science teaching. Teachers agreed by consensus that science instruction improvement was needed at the school and should be included in the school growth plan; if the TPDP were successful, the school would benefit as a whole from having a strong science program for all children. What was less clear at that time was that Nick and Steve envisioned that all teachers would take part in the TPDP, for they had a purpose that was never, to my knowledge, made explicit to teachers: to enhance staff relationships by providing a vehicle to draw all staff members together in pursuit of a common goal. The administrators also thought that whole staff participation would provide what I think of as the "critical mass" that they believed to be essential to the success of the effort.

The vice-principal's recollection: Uneasy lies the head . . . . In February, 1994 I asked Steve to recollect how consensus had been reached that all teaching staff should participate.

Well, it wasn't in a sense an individual choice that each person could make or not make. It was a choice made by a group, a majority of a group, but what that leads to is quite a variation in the degree of commitment people could have . . . . In fact, the group probably includes people who have very little or no commitment to the project . . . . What keeps them coming . . . is that [pause] they understand that it was a group decision that the entire staff should participate. (S. R., DB940202, p. 17)

I asked how that decision had been made, and Steve replied,
Well, that's one of the things I've been always slightly uncomfortable about with this particular project because [what I would have liked to have said was], "I think this is what we seem to be deciding. What I'm hearing you say is that this is important. It's all we're going to do in professional development, we're going to have a course which is going to be credit for some people and not for others, but the expectation seems to be that everyone on staff, whether they're teaching a class or not, whether science is a major interest of theirs or not, is going to attend this, because it is going to be a school wide project and we feel we need virtual unanimity in order to make it more effective. Is that what you people feel?" I think I would have said it that way, so if there were any concerns, any hesitation amongst the people, that could have been argued out amongst the staff and we could have discussed whether some people should have the right to opt out and, if so, who would that be and why, and what harm that might do or not do, et cetera. And that kind of frank discussion never happened. I think what did happen was that there was an agreement, "Yes, we should go ahead with this project", and then there was an assumption that that meant everyone would. (S. R., DB940202, p. 18)

Bonnie, a learning assistance teacher, said something similar. "We decided to focus on [science] and so it was sort of an unspoken thing that we were all going to try science this year" (B. F., SA940421, p. 20).

A teacher's recollection: Uneasy compliance. I asked Teresa if the decision for whole staff participation was as consensual as Bob and I had been led to believe at the start of the TPDP. Her response implied that the commitment of some participants had been assured by the offer of course credit. However, "There were some people that were . . . actually in all honesty, either they have a couple of degrees or they are working on a degree where this doesn't fit, but basically they were requested to be there" (T. F., S940203, p. 3) and they complied.

Teacher Commitment

I feel justified in claiming that TPDP participants were hardworking, committed, professional educators who viewed professional development as an important part of their professional responsibilities. However, their commitment to science as the curriculum focus for 1993-94 varied considerably.
Teacher professionalism. Throughout the TPDP I observed what I characterize as the professionalism of teachers: teachers in animated conversation concerning their children and their teaching; teachers staying late at the school to plan their classroom programs or to do their marking; teachers seeking to improve their teaching and provide an excellent program for their children. The report of the school accreditation process conducted in the school year 1994-95 confirms my impression of the professionalism of school staff. In discussing professional attributes and staff development, the internal team noted the staff's individual and collective sense of responsibility as strengths, commenting that professional development was taken seriously by the staff. The external team reported that they found the staff to be a highly competent and dedicated group of professional educators with many areas of curricular expertise. It is evident to the team that the teaching staff of Mountainview Community School is committed to professional development and the integral part it plays in enhancing student learning. (Mountainview Community School, 1995: Elementary School Accreditation, External Report, p. 21)

Teacher commitment to science. Despite the teachers' professionalism and apparent commitment to professional development, their commitment to science and to the TPDP were uncertain at the beginning of the program. During a planning meeting preceding the TPDP, Steve admitted that he could not tell Bob and me the degree of staff commitment to science as a curriculum area but was pleased by teachers' interest in what he referred to in this conversation as "the sessions". He told us that an unspecified number of teachers had indicated they would participate for UBC credit, but pointed out that this was not necessarily an expression of "some kind of emotional, philosophical, educational commitment to science" for it could signal their commitment to getting 3 UBC credits rather than commitment to science or science teaching improvement (S. R., PL930917, p. 2). The commitment of teachers not seeking credit was largely unknown. As Steve summarized,
I can't tell you what the degree of commitment to science is amongst the staff. . . . People signed up on a sheet of paper . . . to indicate their intention to attend these sessions. On the other hand, there was a fairly clear expectation expressed by administration at staff meetings that people would do so. (S. R., PL930917, p. 2)

I learned that individual commitment to participating in the TPDP varied with respect to, first, teacher interest in science as the curriculum area targeted for professional development; second, teaching assignment; and third, whether or not individuals were receiving UBC credit for their participation.

Teacher interest in improving their own science instruction. In February, 1994, I asked Teresa, to recall the origins of the TPDP. She responded,

We had to come up with a school growth plan . . . and we voted on certain things . . . . Science was way down at the bottom of everyone's interests . . . . It was way down at the bottom because it was something that you pushed aside, not something that you have to do immediately like, it's sort of like art, sort of like, "We're not quite planned for science today so we won't do it." . . . . So when Steve said "Let's have science as our theme; I'm a science specialist" I think we all groaned. I don't think we voted for it actually. I think when it went down the line it was probably sixth or fifth . . . . The computer lab was really big . . . . Assessment and evaluation were there; a lot of people supported getting the library going and putting it onto the computer and those kinds of things . . . . So we talked about it and science became our focus . . . . We went through and said, "Well we've done this and we've done this and we're going to do science next year". (T. F., S940203, pp. 1-2)

Despite Teresa's reference to "everyone's interests", some classroom teachers did talk during the TPDP about how they felt they needed help to improve their science teaching and welcomed the TPDP as an opportunity to do so. Trixie spoke about her commitment to attending workshops; her comment is representative of comments of many classroom teachers, for she viewed the TPDP as an opportunity to satisfy a personal goal.

I knew it was important that I attend every session . . . . I wanted to find a new way of looking at science and not be afraid of it, and to feel more comfortable and relaxed in going and teaching science. (T. N., SI940421, p. 6)

For others, however, science was not as much of a priority. For example, I discovered that Lily had a lively science program, including outdoor education activities, in place at the beginning of the TPDP; Elizabeth had involved her children during the previous year in
a gardening project in which they turned a plot of land in front of the school into a butterfly garden; and David had begun using Innovations in Science materials prior to the TPDP. However, these activities were rather low-key and represented only a few of the classroom teachers. These teachers were keen participants in the TPDP for they enjoyed the workshops, found them relevant to their teaching assignments, and found the TPDP enhanced their science teaching regardless of their starting point. However, Evelyn, a kindergarten teacher, who stated that she enjoyed science before the TPDP and felt comfortable and confident with her science teaching, said she found some of the workshop activities too difficult for her students and did not take advantage of the offer of classroom support for she felt it would be too disruptive to the short kindergarten day. While she found the workshops enjoyable, the limited impact on her classroom teaching did not warrant the big time commitment (Mountainview Community School, 1994: Science Project Participant Survey). She was also concerned, as staff representative for the local teachers' association (union), that the administrators' requirement that all teachers attend after school workshops went against the teachers' contract (FN940504).

**Teaching assignments.** Non-registering teachers, that is, Frances, the teacher-librarian, and Bonnie, Tammy and Trudy, the three learning assistance (LA) teachers viewed science as a less than pressing need with regard to their teaching assignments. A fifth, Kay, was a teaching assistant who took part in the course voluntarily and received course credit for her participation; for the purpose of this discussion I include her in the non-registering "teachers" for she was a staff member and a member of our group. All of these teachers attended workshops throughout the year and participated in workshop activities and discussions with, it seemed to me, enjoyment and, in some cases, enthusiasm. Three of these teachers were motivated in part by working towards UBC course credit. All but one of the five worked on a science project for at least part of the year even though this required finding a connection between science and their teaching assignments; the exception was a non-registering teacher not receiving UBC course credit.
Teachers receiving course credit said that they received good value for their commitment of time and effort. As Lily said at the end of year roundtable discussion,

To come for a couple of hours after work was hard for some people. I know [that] otherwise we'd have staff meetings, but you don't always have to use your brain then. Or we used to have one Wednesday off a month, and then we didn't. But when you compare with going to UBC and all the time you'd spend in traffic, money and time, what we put into it was very little compared to what we got out of it. (L. N., RT940504, p. 10)

Leanne observed, "All the energy that is sapped in traveling we put into what we were doing, into our classes" (L. M., RT940504, p. 10).

Even so, Steve was concerned about the participation of the five non-registering teachers. He told me,

There was a hint at the beginning that some people felt unsure about whether they had to attend or not . . . . Nick conveyed to them that this was a staff decision that the entire staff participate, and that we had promoted it to both the district office and the Parent Advisory Council who were giving us $3000 . . . . That's what we had said and so now we better do that . . . . I got quite nervous about the degree of commitment and participation and whether people were feeling coerced and whatnot, especially amongst those who don't register a class. (S. R., DB940202, p. 18)

There were three aspects to Steve's concern: first, that these teachers would find the content of the workshops unrelated to their professional responsibilities; second, that they would be unable to try out activities between workshops and so not participate fully in workshop discussions of classroom practice; and third, that their after-school time, always at a premium, could be spent in other ways that might better support their teaching. His remarks to me in January, 1994 reveal how keenly he felt the responsibility of being the school's project facilitator.
It really was bothering me that the teachers -- I shouldn't say the teachers, the participants, because that includes the teaching assistant -- who do not have a class with which to work, were to some extent wasting their time or at least they were not getting the payback that they should from the time they are investing in this project. It was a major concern of mine because, at the same time, I was feeling like there was a very subtle coercion for them to participate. Had they been given a totally and completely free choice they may not have shown up to these Wednesday sessions because it didn't relate to their job. So combining the fact that I was afraid that maybe there had been a subtle coercion and then the payoff wasn't happening, seemed like such a huge responsibility. (S. R., DB940119, p. 7)

Steve felt it was time to confront his concerns and meet with these non-registering teachers. He discovered that three of the five were working towards course credit and so felt they were benefiting from their involvement. They had solved the problem of not having a classroom of children to work with and started on a project for a course assignment (DB940119).

UBC course credit. These three teachers were determined to find a way to fit the course into their program of studies, but one teacher was faced with a dilemma: How could she honor her responsibilities as a learning assistance teacher while at the same time practicing the science strategies she learned in the workshops? She said,

I tried it [teaching science] with my ESL [English as a Second Language] kids and I realized that [given] the level they were at in English, it wasn't fair to them not to stick with teaching them English because science vocabulary is not what they needed at this point . . . . So I got frustrated with that and then I couldn't figure out how I was going to fit in trying science. (B. F. SA940421, p. 20)

She resolved her dilemma by team-teaching a science unit with a classroom teacher. Each teacher benefited from the collaboration: The learning assistance teacher developed insights into the special needs children in the class who were part of her teaching responsibility, and the classroom teacher, struggling with a large and difficult class, felt encouraged to get started teaching a unit. Both teachers found this a rich collaboration (B. F., SA9404221; K. D., LJ940421).

The second participant working towards course credit was Kay, the teaching assistant. She hoped to return to university to become a teacher and felt that this course helped her
get started on reaching that goal. She worked with children on science activities in a variety of ways throughout the year, in the kindergarten, one-on-one with special needs children in her charge, and in her home with a neighbor's child. She felt she learned much about children's learning from these sessions and received the course credit that she desired (EJ940421).

The third, a non-registering teacher receiving course credit was Frances, the teacher-librarian. She worked on a project relating library resources to science, which fitted into her program of studies for a diploma in library science. She said at the end of the year that she accomplished a lot: She arranged to have several authors of science-related literature visit the school to make presentations to the children, worked with children from a number of classes on research skills using science books, and ordered student books and professional materials using funds from the science budget. She posted a list in the library on which teachers wrote their science units so teachers could share resources with one another and developed a set of science-in-a-bag projects using science activity books from the library. Although she hadn't done everything that she had hoped to do, the TPDP helped her focus on science, which had never been one of her favorite subjects (EJ9404321).

Non-credit, non-registering teachers. Steve was particularly concerned about Tammy and Trudy, who were not receiving course credit. He met with them at the second workshop in January, 1994 and told the planning team of their conversation.

They told me that this wasn't a problem, that yes, it's true that they were having a difficult time... integrating the project into their job, and in fact really it wasn't being very well integrated into their job at all. That wasn't happening. But it was their sense that their coming to the Wednesday sessions was still very worthwhile for them. (S. R., DB940119, p. 7)

In February, 1994, he said he didn't think their participation had been questioned since then:
It was an incredible relief to me because I was afraid that we had subtly coerced people, to put it frankly . . . . [They] said to me, "You're right that it's not equally applicable, I'm teaching learning assistance, I'm doing language arts and math all day long with . . . one or two students at a time and I'm not going to have time to put these [science] things into practice." [However] the other thing they said to me was, "But, I could easily take a Grade 4 class next year", because as a learning assistance teacher you have no guarantee in this day and age that that's what you'll be doing next year . . . . And I found that most encouraging. (S. R., DB940202, pp. 18-20)

I observed these two teachers' enjoyment of the science activities and participation in the camaraderie of workshops. Two weeks after Steve's conversation with them, I noticed that one of these teachers, not usually outspoken, volunteered an observation she had made in the primary class where she provided prep time for the classroom teacher by teaching language arts. She expressed amazement at the vocabulary that the children used in their building work when they talked about how "the sides support the weight" (T. C., CL940202, p. 5).

I discovered at the end of the year that classroom teachers were aware of the difficulty the non-registering teachers had fitting into the TPDP. As Lily said, "I think it was good that all the teachers came, although I know the LA [learning assistance] teachers couldn't figure out what they were going to get out of it " (L. N., RT940504, p. 9).

New teachers on staff: In addition, there were several teachers new to the staff who felt compelled to go along with the TPDP. At the end of the year, Bob asked Leanne about this and she recalled,

I just arrived on staff in September and I knew nothing of it. I did none of the preparatory thinking . . . . So suddenly I arrive in September [1993] and I'm told that we're taking a university course all year long and that all of our professional development is science. (L. M., D940407, p. 17)

But she also saw the TPDP as an opportunity.

I've been unhappy with my science teaching . . . . I thought, "Oh, this could be really good!" I didn't like having to spend the money initially [on UBC course fees, for she elected to work towards course credit]; I hadn't budgeted for that . . . so that was a big shock. (L. M., D940407, p. 18)
To summarize, while all staff participated in the TPDP, commitment at the outset was uneven and related to teachers' interest in science and their teaching assignments. The availability of UBC course credit was a bonus to classroom teachers already interested in improving their science teaching, an incentive to teachers who were not especially enthusiastic about teaching science, and both an incentive and an unexpected opportunity for professional growth for non-registering teachers.

An Unstated Purpose of the TPDP: Enhancing Staff Relationships

The administrators insisted that all staff participate in the TPDP as a way to enhance staff relationships. They facilitated this with two leadership strategies: First, they put a great deal of thought into planning a program that would be attractive, beneficial, and as easy on teachers as possible and second, they exerted administrative pressure that I found sometimes hard to distinguish from coercion and gave me much to think about.

Pulling staff together. At the beginning of the TPDP, Steve was beginning his second year on staff and Nick his third. The school, although a replacement for a previous school, was only 2 years old, and a number of new teachers had joined the staff during that time. I referred earlier in this document to the sometimes tense relationships among staff members prior to the TPDP. Nick stated that finding common ground was not always easy with this staff, and he wished to have all staff members working together towards a shared goal. In talking about the inclusion of science in the school growth plan he said,

Science was the one thing [they could agree on], because it was new: Nobody had focused on it before. It was a way of uniting the whole staff, you see, because they each had their own little focus areas. It was something they could agree on. (N. F., PL930917 p. 12)

A critical mass. With what they thought was teacher support for all staff to participate, the administrators had the critical mass essential to its effectiveness (DB940202). By making the TPDP the major teacher professional development effort for the full school year, they could allocate a significant amount of school funds to the effort. By including all staff, the TPDP was a powerful public relations maneuver that impressed parents and
appeased critics; including UBC personnel added a certain cachet to the endeavor. Nick and Steve presented the TPDP to parents as evidence that staff members took parent criticism seriously and were making an effort to address the perceived problem. This also gave the administrators an argument to request PAC funding to support the initiative. This maneuver had the effect of taking some pressure off teachers; in fact, Nick referred to parents as

unsung heroes who have contributed to the success of this project. . . . The parents, . . . I'll bet, gave us moral support in the community because demands from the parents for us to do this, that, and the other thing have either dropped away completely or they are so easy to deflect that you cannot help but believe that there is support in the community: someone saying, "No, no! They are doing something this year". (N. F., DB940316, p. 20)

A house of cards. Assembling these funds was a synergistic process. As Steve summarized towards the end of the year,

All these cross connections work really well. . . . We have had travel expenses cheaper than we might otherwise have had, contributions from the PAC which . . . have been significant: $3000 over a period of 2 years for the purchase of materials and whatnot, has enabled us to relax an awful lot. Every time you add an element to the thing, it makes it attractive enough that you can attract another element. The fact that I was able to get you [Bob], and then you were able to bring you [Clare] in . . . resulted in us getting a . . . $4000 grant from the province, the Ministry [of Education]. The fact that you [Bob] were involved got us another $3000 grant from UBC which enabled us to hire substitute teachers which enabled people to have time off for planning. And remove any one element from the house of cards that we have built here and it may indeed fall down. (S. R., DB940316, p. 19)

Support at the district level. By framing the TPDP as the only professional development focus for the year and attended by all staff, the administrators were assured of the support of the school district superintendent and could resist pressure on teachers to attend other events.

Our very powerful superintendent is aware of this program, and so people who are going to put pressure on the school to participate in things, they know they are not going to get a sympathetic hearing from [name deleted: the superintendent], so if I say "No", they know [the superintendent] is going to back up the "No", and so they go away. (N. F., DB940316, p. 20)
The TPDP was also supported by two local school board members whose children attended the school.

**Laying the groundwork for the TPDP.** The administrators were well aware that this ambitious program would require considerable teacher commitment of time and effort to reach its objective. They knew that the demands of teaching at Mountainview School kept the teachers very busy, and so laid the groundwork carefully for the year of workshops so as to make teacher participation as easy and as rewarding as possible. Steve referred to this as a "cost-benefit ratio" in his report on the District Elementary School Science Improvement Project (DESSIP) and recommended that professional development initiatives keep this ratio low. Nick told me in a conversation in November, 1993 that he and Steve tried to keep the cost to teachers low for "The whole world seems sometimes to be competing for the individual teacher's attention" (N. F., DB931103, p. 33).

Later in the year, Nick drew my attention to "the absolute necessity of removing as many distractions as possible. You just say to people, 'The only major demand going to be on your time this year is this'" (N. F., DB940316, pp. 15-16).

**Busy teachers.** The administrators knew that teachers were always pressed for time, and felt responsible to use teacher's time wisely. Teachers often described themselves with words such as having "too many things to do" (M. Y., CH940211, p. 6; also F. C. FN940504). I saw this for myself a number of times. For instance, lunch break was short for Marjolaine on a day I was at the school. After she ate quickly, she supervised a volleyball practice, explaining that she found this difficult but that practices had to be at lunch time since Mountainview is a bus school (SF931021). In Spring, 1994 I went out to dinner after a workshop with a group of six teachers. They said their goodnights at 9:45 p.m., apologizing for ending our pleasant evening and explaining that they had marking to do. I also learned from our dinner conversation that each teacher had had an illness or family troubles during the TPDP. Despite this, all spoke cheerfully about their profession (FN940420).
When I asked Teresa where she found the time to prepare and set up for hands-on lessons, she described what she thought of as a typical day:

What time did I go home last night? I was home by 6:15, made dinner, ate, and by 8:30 I was back marking, and marked until 11:30. This is my every night. It's the sheer number of everything... The load is getting heavier rather than lighter, [with] more expectations... I used to do clubs and sports, I still do student council... I'm not wasting my time, I'm a very organized person... I don't know where all these expectations, demands, meetings [come from]. (T. F., S940203, pp. 9-10)

Later in our conversation she added,

I have a family that understands. My daughter says, "Mummy, you work too hard. Can I do your marking?" [My husband] knows how hard I work; last night he marked all my math tests. They are being supportive. I'm lucky; I can see why some people become single. (T. F., S940203, p. 13)

She commented, "We walk around with our Daytimers!" (T. F., S940203, p. 18).

Protecting teacher time. Clearly, making time for the TPDP so that it would not cost teachers much personal time, that is, time outside the regular school day, was a good administrative strategy. As Steve commented to Nick,

One of the most important things we've done to help them [the teachers]... is, we have set aside four hours a month... where there is nothing else on the agenda except the consideration of science teaching. And that's the single most important thing I think that we've done. (S. R., DB931103, p. 43)

Nick and Steve made time for the workshops by reducing their customary two staff meetings each month to one, using the freed afternoon and another for workshops. In addition, by scheduling workshops for Wednesday afternoons, they were able to start the workshops at 2:30 p.m. and end at 4:30 p.m., for Wednesday was the school's early dismissal day. They devoted two of the school's professional development days to the TPDP.

Workshop ambiance. Nick and Steve worked with Bob and me to set a relaxed and positive tone for the workshops by creating an enjoyable ambiance with food and fun. The first workshop began with caffe latte for all, suggested by Steve and Nick and paid for by
individual teachers. When the planning team debriefed that important first workshop, Nick noted the "caffeine in the air" (OB931006, p. 20) and proposed that we establish a tradition that each workshop would provide coffee or some sort of snacks, paid for from the staff development fund (DB931006). Thereafter teachers arrived at the workshop to find a variety of fruit, corn chips and salsa, potato chips, and/or cookies.

This tradition of sharing food enhanced the relationship between teachers and the planning team. Steve, Bob and I shared the task of buying and preparing the snacks just before each workshop began. I have a clear recollection of two teachers entering the kitchen in search of a cup of coffee, to find Bob, Steve and me chatting and washing fruit. The teachers looked startled, then amazed and delighted to see us performing this mundane chore. They seemed quite merry and pleased as they recounted to others that the food was in the kitchen and that Bob and I were in there with Steve cutting up fruit. Several other teachers came in to help put the snacks out on tables. Teachers later pronounced the array of sliced papayas, melon, strawberries, grapes and chips and salsa "absolutely the best" (CL940119). It struck me as remarkable and in a very quiet way important that Bob took part in these preparations and I think this simple and ingenuous act endeared Bob to teachers and went far to establish a tone of collegiality and approachability, in contrast with the reserved academic I sensed they expected.

This consideration of teachers' needs was effective; Nick said before our first workshop,

> I think we've both been quite gratified at the response of the staff overall. We anticipated resistance, pockets of resistance, and they haven't really materialized. (N. F., PL930917, p. 12)

However, later in the year he acknowledged that there was some teacher resistance just before the first workshop. He commented,

> When people resisted in the beginning, and there were resisters in the beginning, they didn't really have alternatives in that . . . they couldn't justify absence by saying that there were these other [professional development] demands. I think some of them went along because, well, "What the hell, this is really all we're going to do anyway" (N. F., DB940316, p. 16).
His statement hints at what I find an interesting grey area in program planning, between administrative leadership and administrative manipulation, and I wonder when leadership becomes imposition.

Leadership: Pulling, Pushing, or Just Making a Decision

The vice-principal told me how, prior to the first workshop, he overheard a group of teachers asking one another, "Well, are you going to the science thing?" "No, I think I'm going to ... ". Steve alerted Nick and they discussed whether attendance should be optional. The administrators agreed that they had given the Parent Advisory Council (PAC) the impression that this was a school-wide effort involving all teachers, for that's what they felt had been decided by staff when the TPDP was planned. The PAC responded with $3000 to support the project and the project became part of the school growth plan. Therefore, to honor these promises, all teachers should attend. The principal decided he would be the one to remind those teachers that it had been a staff decision that all teachers attend; he did and they did (S. R., RK940203).

Throughout the year, I struggled to distinguish between administrative leadership and imposition in the administrators' insistence that all teachers participate. I was not alone in questioning this aspect of the TPDP. Steve was anxious before the first workshop and saw that he and Nick faced a dilemma.

On the one hand, Nick and I felt it important that it be a school wide effort . . . that whole staff [be] involved. But you have potential to turn people off of worthwhile projects by forcing them to do something they don't want to do. So that dilemma, which has no correct answer, you have to struggle with . . . . I'm not feeling bad, considering the various and sometimes conflicting needs of the project, we have walked as good a line as we could. So, although occasionally I am lying awake during the night thinking about it, in retrospect we've done all right. (S. R., RK940203, p. 2)

Steve told me that he and Nick were prepared, in his words, to "back off" if they encountered too much resistance to whole staff participation. "For the first couple of sessions, we were watching things very carefully; we decided after the first couple of
sessions it appeared to have been the right decision [to insist that all teachers participate]" (S. R., RK940203, p. 31). I asked him to tell me how he perceived his leadership role in the TPDP, and he replied,

I can think of times when I have said to myself, "I think it's time that we did x", which may seem pushy, but my sense is that the group is looking for leadership. Sometimes leaders just have to push, or maybe pull. One occasion was [when] we realized . . . that, while we were talking a lot about science, not nearly as much was happening in the classrooms as we had hoped . . . So at that point we said, well, do we just keep subtly talking about barriers and issues and how to remove them, or do we come out up front and say, "Okay, it's time you got something going in your classrooms, and if you haven't already then the expectation is that you will have by the next session. Period." My instinct was that it was time for leadership, or pushiness, whichever. I think our experience since then has borne out that it was a good decision. At the time I wasn't sure, but my best guess was that it was the right thing to do. (S. R., RK940203, p. 3)

His next comments reveal how he struggled to reconcile leadership with respect.

Sometimes being respectful of them [the teachers] is giving them the leadership that they seem to be wanting. I have heard of staffs saying, "Just tell us what to do now; we've talked enough, so somebody make a decision and let's get on with it". . . . Someone has to decide, and frequently they look to an administrator, particularly if the administrator has some credibility. If the administrator won't take that role, that administrator loses respect . . . . You can get away with a small percentage [of teachers] disagreeing, because they would sooner have that sometimes than have no direction all the time. (S. R., RK940203, p. 4)

Steve described his leadership policy: "If you get some form of ambivalence out there, which actually means you are doing fine, then it becomes up to you to propose what you think is the next step is and see if everyone agrees" (S. R., CH940211, p. 10). However, he also said, "There is this tension between having the maximum amount of input and participation from the group . . . and providing some form of leadership" (S. R., DB940105, p. 11) to which Bob responded, "And that's an interesting tension that must be played out continually in the schools" (R. C., DB940105, p. 11). This issue never really resolved itself; we just walked a fine line all year.

Three teachers' views on leadership. A number of comments made by participants illuminated for me the fine line between leadership and imposition. Teresa told me, "When
we first talked about having this program and having everyone participate, I got my nose
out of joint because I hate being told what I have to do" (T. F., S940203, p. 1). I asked
her, "What if it had been, 'Come if you are interested?'" she replied, "I think it would have
had a different feeling. The teachers who were sitting at the back are now getting
interested" (T. F., S940203, p. 4) and added that this would be good for the school.

Bonnie, a learning assistance teacher, described herself as an art teacher who had
never taught science before this year (B. F., SA940421, p. 15). Towards the end of the
TPDP she said that, for her, the expectation that she participate fully in the TPDP had a
positive outcome for, at the beginning of the TPDP, she was afraid to teach science. Her
confidence at the end of the year made her happy.

I think I've learned a lot, I put a lot of effort into it, but the amazing thing for me
was my change in attitude about teaching science. My attitude changed because I
tried it for one thing, which I never would have on my own, if I could have
avoided it . . . . It became quite a painless process, and I actually enjoyed it. (B. F.,
SA940421, p. 27)

On the day following the workshop in which the administrators informed the teachers
they must select and commit to teaching a science unit, I told Bob and Steve what Kay
had told me that morning.

She felt that it was really good that you [the administrators] had put [out] an
ultimatum . . . . She said to herself, "I really needed that . . . because I need a little
pressure to get me going . . . . Other things get in the way, you get busy". (C. B.,
DB940119, p. 15)

To summarize, from the teachers point of view, it was a good idea to include the
curriculum area of science in the school growth plan and they were in favor of the TPDP.
However, a number of teachers excluded themselves from the need to participate in this
ambitious project; they participated only because the administrators "requested" them to
do so.
Teachers' Comments

In his end-of-year survey, Steve asked teachers to comment on the participation of the whole staff in the TPDP. The diversity of teacher responses highlights the dilemma implicit in whole staff participation, in including registering and non-registering teachers, and credit and non-credit participants. While some teachers made comments such as, "It required full staff involvement to be effective" and "It really got the entire school working on one goal; that was positive", others noted that "At the professional level, the science course was interesting, but not high on my list of priorities/interest, so the requirement to participate was somewhat onerous" and "Unrealistic to do as a school-wide project again" and "Should be optional". One teacher commented, "Somehow there needs to be a way to allow for everyone to benefit. I spent a lot of time discussing something that I don't teach" (Mountainview Community School, 1994: Science Project Participant Survey).

A non-credit classroom teacher proposed an alternative to compulsory participation in her response. She stated that she enjoyed the TPDP experience but wrote,

If you are a non-credit student . . . you should be treated as a professional who knows how much development in science you need for your own growth and not be forced or pressured into attending all sessions or for the entire duration of each session. One can still be immersed in science as a school focus without going to all sessions as a credit student must do. (Mountainview Community School, 1994: Science Project Participant Survey)

Her words reveal that, even at the end of the year, she made a distinction between credit and non-credit participants and was aware only of the program's explicit purpose of improving individual teachers' science instruction. Despite her implied reluctance, she concluded that she enjoyed the interaction with the other teachers, was "glad we did it" and would welcome any future opportunities to take a credit course at the school. "This was an experiment," she wrote, "and with all experiments adjustments must be made for the future" (Mountainview Community School, 1994: Science Project Participant Survey).
This dilemma is, for me, unresolved and I do not know what I would do next time other than be explicit about all goals of a program.

The Issue of Offering University Course Credit

The second feature of possible interest to staff developers was the offer of university course credit to program participants. Teachers valued this opportunity, but it did cause some confusion and problems for the planning team.

A School Project and a University Course

When a teacher asked at the March, 1993 staff meeting preceding the TPDP whether she could receive course credit for her participation, it seemed like a good idea. A professor visiting a school on a regular basis over a school year provided an unusual opportunity for teachers to get 3 credits in an off-campus course. However, once course credit was made available, the administrators and teachers recast the series of workshops as a UBC course, a perception not shared by Bob for he intended to visit the school to support their school initiative, not to "run a course" at the school.

The professor's perspective. Offering course credit for teacher participation did not change the nature of the endeavor for Bob, although he anticipated that by so doing we might confuse the orientation and ownership of the program. He referred to this as the "complementing and complicating factor of university credit" (R. C., PL930917, p. 15).

As he and I drove to Mountainview for a planning team meeting in mid-September, 1993, prior to the first workshop, Bob told me,

We have to communicate the idea that they are going to do the school project and we are going to find a way to meet the requirements of the university so that they will get university credit. That is our fundamental orientation. I suspect we ought to say, "What is it that you would want to do that would be useful to you, and let's talk about which parts of this we will look at within the context of university credit" (R. C., CR930917, p. 11).

When he presented this notion to Nick and Steve, they were relieved for, as Steve said,
As the school administrators, of course, what we're really interested in is effective science instruction and it doesn't much matter to us about people getting credit or not getting credit. Well, that's not entirely true, we'd like them to get what they'd want, which is evidently credit, but . . . our first priority is that this be an effective learning experience that carries over into the classroom. (S. R., PL930917, p. 15)

Even so, their words in subsequent discussions showed that their notion of Bob "running a course" persisted.

Supporting a project or running a course? Although this strategy seemed straightforward to Bob and me, we found it not to be so for staff members. By the time the TPDP workshops began, many staff members referred to the series of workshops as "the course". The confusion between the series of hands-on workshops agreed to by Bob, and what teachers came to refer to as a UBC course offered at their school, caused ripples of concern for several weeks for both the planning team and the teachers.

Classroom projects or course assignments? Bob imagined that teachers would do more than just attend workshops as part of this school improvement effort. He knew the importance of intensive teacher involvement in classroom settings in achieving the school's objective and assumed that teachers would design and work on classroom projects between workshops. He planned to use these classroom projects for course evaluation purposes. However, Steve assumed that Bob would have expectations of the credit students that went beyond the school improvement effort, for he did not see how Bob's imagined classroom project could be one and the same as an assignment evaluated for credit. Steve said,

This is a topic which needs to be explored with the staff on the first session, because I suspect that there will be some anxiety about what your expectations are. "How much work is there going to be to this? What kind of evaluation and assessment will take place?" in order that they get their credits . . . . In order at least to get those concerns and anxieties out of the way, you need to take a little time in that first session. I realize that we've only got a couple of hours per session, and by the time twenty people get their questions answered you may use up a half an hour discussing those mechanical things, but I think they do need to get done. (S. R., PL930917, pp. 15-16)
Nick added, "It could be maybe less onerous on everyone if those people who are pursuing credit meet separately to discuss and negotiate how they're going to achieve that" (N. F., PL930917, p. 16). In so doing, he revealed that he, too, imagined a difference in the way credit and non-credit students would participate. Bob pointed out a danger in meeting separately with credit students.

I wouldn't want to produce two populations of people . . . . I wouldn't want the people who are not doing it for credit to think that it's going to be much lesser for them . . . . We thought that many people would want to do the same sorts of things, representing in some way what's happening in their classroom or what's happening to them or what's happening to their children. (R. C., PL930917, p. 16)

Bob proposed that we explore with the group the kinds of things that would help them address the school objective and would also be acceptable to us in meeting the university expectations for awarding three credits. Bob explained,

The richest way to do this is to go to the people who are going to do the job . . . . and then share with them some of the ways that we have found in the past, like people keeping logs, or people writing case studies of what happened in the classroom. Or if someone said, "I really am very handy with the video tape recorder. I will make you twenty minutes of what really represents what is the richness in my classroom". Or present us with a nice portfolio of children's work (PL930917, pp. 16-17).

At our first workshop we found that teachers, too, were expecting us to "run a course". Bob was eager to set the tone of the workshops by immediately engaging teachers in a hands-on science activity; this took approximately an hour. However, as soon as Bob finished debriefing the activity, Leanne spoke up, saying that she had not yet decided whether to participate in the workshops for credit. Time was important to her, she said, and she wanted to know how much work would be expected. How much would course assignments take away from time she'd rather spend doing things for her classroom? (OB931006). Her comment was only the first of many during the year that revealed that teachers now expected Bob to teach what they thought of as a traditional university course rather than to help them with their initiative.
When the teacher posed her question, Bob was in front of the group while I was sitting at the back taking notes. Bob shot an inquiring glance at me over the heads of the teachers and I held up my hand indicating zero; Bob mirrored my signal to the teachers, so reassuring them of his resolution that our work together would focus on classroom practice. Steve recalled that moment after the workshop. "I was so glad to see zero because zero is so absolute, you know, it's not a waffle, it's an absolute" (S. R., DB931006, p. 2).

Despite Bob's response, teacher's concerns were not allayed and teachers continued to differentiate between what they might do to work towards the school objective and what might be required to get course credit. As Steve commented after the workshop,

'[You know] what surprised me? . . . L. M.'s unwillingness to be persuaded that . . . there wasn't going to be some unpleasant surprise sprung [later] . . . That it's all right to have this friendly conversation here, but if I sign up [for credit], later in the course there's a risk that some unpleasant surprise will be sprung, and the unpleasant surprise will involve a whole pile of work that I don't have time to do. The time or the inclination. (S. R., DB931006, p. 11)

This issue was not settled by the end of the workshop and we resolved that we would, after all, meet with credit-seeking students alone prior to the next workshop to work out the details. At that time, teachers insisted that Bob tell them what they had to do for an assignment. One teacher stated,

'I would like that . . . [it not be] a guessing game, that it's very clear that if you want an A, "Thou shalt do such and such"; and for a B, "Thou shalt do such and such". I don't want it to be a guessing game . . . I want to know what you have to do to get 80%. (E. I., SM931020, p. 2).

"The course". Despite Bob's protestations, for the remainder of the year staff members often referred to the workshops as "classes" and to the series of workshops as "the course"; with time, so did Bob and I. However, with Bob's insistence that we were engaged in a school improvement project and with his invitation to teachers to take an active role in collaborative planning, the line between course and project blurred as the
year progressed. To allay teacher concerns, Bob offered teachers a course outline in which he stressed,

The Mountainview location provides a unique opportunity. For the first time in BC, we think, a university course will serve as the context for a school faculty to examine science teaching as a center of interest for one school year, and provide university credit for those seeking it . . . . The goal is to construct a course, through negotiation that, at one and the same time, serves the practical need of school personnel seeking to establish science as an important strand in its day to day operations, and meets the university requirements for credit . . . . The overarching purpose is to examine teaching practices and the learning of science and have each participant arrive at decisions about what suits their classroom and teaching style while cooperating in a school-wide project. (1993, Science Education 409 course outline)

In so doing, Bob proposed a way to meld a university course and a school initiative, a way to bridge the gap between theory and practice, so bringing to the endeavor the best of the world of academia and the world of the classroom.

Reflections

Examining how issues such as these were managed during the TPDP were, for me, one of the most interesting aspects of the program. From the perspective of an outside staff developer, this comprehensive, ambitious approach to teacher professional development was certainly a challenge to run, had no imagined guarantees, and often had the feeling of flying-by-the-seat-of-the-pants. However, it had an excitement and satisfaction level unlike any previous professional development initiatives in which I had been involved; I can only compare it to the thrills and immense satisfaction I find in classroom teaching.

One of the novels that I read during the TPDP was Timothy Findlay's (1993) Headhunter. His characterization of the book's central figure, a psychiatrist, struck me at the time as being extraordinarily perceptive. While I do not see a clear parallel to Bob in the character Marlow, I feel that Findlay's words are an apt description of a university-based staff developer's involvement in a school-based initiative:
Marlow's world was once again made up of equal parts of what he knew and what he didn't know. He had been wary, up until today, of going back into practice after being so long in the lecture hall. But for him, the lecture hall had become a sterile place -- so long as he was the speaker there. He was back out, now, in the fertile world -- where theory could not protect him from the chaos of other people's lives -- and the mayhem of reality. (Findlay, 1993)

Areas for Further Study

The TPDP was an effective strategy to address the need for improved science instruction at Mountainview Community School. Teachers, administrators, and parents were satisfied with the outcomes of the program. TPDP participants, both teachers and facilitators, were enthusiastic about this alternative approach to teacher inservice. Five areas of interest emerged during my research that were not within the scope of this study. Research in these areas would contribute to our growing understanding of the effects of school initiated teacher professional development.

1. **Ongoing, shared staff development.** We need a better understanding of the effects on a school staff of ongoing professional development activities that are a regular part of the school year. My sense is that the TPDP had a value to staff members that went well beyond its purpose of improving science instruction. For example, teachers spoke of how much they enjoyed getting to know one another better; administrators said they saw an increase in what they termed professionalism among staff; parents were outspoken about how impressed they were with the staff's efforts to improve their children's educational program, indicating improvement in teacher-parent relationships. However, the TPDP was a special event for the school. If such extensive and extended professional development were a regular feature of every school year, how would staff relationships and the school tone be affected?

2. **Teacher confidence and involvement in curriculum development.** We need to examine the effects of school initiated and school designed inservice on teachers' alertness to their "lived curriculum" (Aoki, 1993) and their ability to design curriculum to suit their
particular students. Lived curriculum is the curriculum experienced by children and teachers as the curriculum-as-plan comes alive in the classroom in response to the uniqueness of the children's interests and to local events. Teachers played a major role in TPDP design so that it would meet their particular needs, and the planning team encouraged them to adapt workshop activities to meet the needs of their particular students; it would be interesting to see in what other ways they designed their curriculum. Does such school-initiated and school designed inservice provide teachers with the interest, knowledge, and confidence needed to move beyond curriculum-as-plan, to develop classroom curriculum with their students?

3. **School staff and university personnel working cooperatively in a school setting.** We need to explore ways in which school staff and university personnel can work together in the school setting, such that the needs of each are met. In my experience, universities and schools have few direct links, other than the occasional university-initiated research project that uses the school as the research site. The TPDP combined a school improvement project and a university course and provided the venue for this case study. In what other ways might we design projects such that the purposes and reward structures for both partners are taken into account?

4. **Inservice programs and student learning.** We need a better understanding of the impact of such inservice programs on student learning. The scope of this study did not include examination of changes in the students' learned curriculum. Teachers talked about how they improved their science instruction, parents said they were delighted with their children's enthusiasm for school science, and the accreditation process found student success in science to be satisfactory, but were children learning more about school science? Does such extensive and extended staff development improve student learning?

5. **Long-term effects of inservice on teachers' instruction.** Too many of our studies are of short duration; we need to examine the long-term effects of such a program on
teachers. My sense is that significant changes occurred in the teachers' science instruction during the year of the TPDP, but how long-lasting were these changes? Teachers themselves were concerned that, without a continuation of the program into the following year, they would lose momentum. We need studies which examine the impact in, say, five years time, of such staff development on teachers' practice. Would teachers identify any residue of such a program in their teaching?
BIBLIOGRAPHY


APPENDIX A

MOUNTAINVIEW COMMUNITY SCHOOL SCIENCE PROJECT

PARTICIPANT SURVEY

Mountainview Community School Science Project
Participant Survey

Introduction:

This survey has several purposes:
- to provide us all (school and UBC personnel) with information helpful in planning future professional development projects
- to provide participants an anonymous means of offering suggestions and expressing opinions

The results will be distributed to all participants, and will also be made available to Clare for use in her research, and to any other school district or university personnel who might find them useful.

Thank you for giving your time to complete this survey!

Instructions:

- Please check the appropriate box.
- Select one best response for each multiple choice item.
- Where space is provided for comments, please feel free to do so.
- Use the reverse of each sheet if there is insufficient space for your comments.

1. Please indicate your current assignment (if split, indicate the category to which the majority of your students belong):

   □ K - 3
   □ 4 - 7
   □ Not registering a class this year
2. Please indicate your years of teaching experience:

- □ 5 or less
- □ 6 - 10
- □ more than 10

3. In the previous five years of teaching (or less, if you are a new teacher), which statement below comes closest to describing your involvement in science professional development?

- □ no science professional development
- □ one or two short (one day or less) experiences
- □ a credit course in science education
- □ other (please describe briefly)

Comments:

4. To what extent did your class receive an appropriate amount of science instruction this year?

- □ a great extent
- □ some extent
- □ very little or none
- □ question does not apply to my assignment

Comments:

5. To what extent did the Science Project have an impact on the amount of time your class spent on science?

- □ a great extent
- □ some extent
- □ very little or none
- □ question does not apply to my assignment

Comments:
6. Another purpose of the project was to ensure that our students had ample opportunity to engage in direct "hands-on" science activities. To what extent do you feel that this has happened in your classroom this year?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:

7. To what extent did the Science Project have an impact on the amount of time your students spent doing direct, "hands-on" science activities?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:

8. A project of this nature should improve student attitudes toward science. To what extent do you feel this project contributed to improved student attitudes toward science? (select one response):

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:
9. To what extent are you now a confident science teacher?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:

10. To what extent did the Science Project contribute to your confidence as a science teacher?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:

11. To what extent do you feel you are now proficient in science instructional skills?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:
12. To what extent did the Science Project contribute to growth in your science teaching skills and methods?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:

13. To what extent do you now enjoy teaching science?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:

14. To what extent did the Science Project contribute to growth in your enjoyment of science teaching?

☐ a great extent
☐ some extent
☐ very little or none
☐ question does not apply to my assignment

Comments:
15. Another possible outcome of a professional development project which involves a whole staff is the development of an increased degree of cooperation and collaboration within the staff. **To what extent do you feel this project helped to improve cooperation and collaboration within the school staff?** (select one response):

- □ a great extent
- □ some extent
- □ very little

Comments:

16. The school purchased the Innovations in Science materials. To what extent has this proven helpful to you this year?

- □ a great extent
- □ some extent
- □ very little or none
- □ question does not apply to my assignment

Comments:

17. This is the first time that a credit course has been made part of our staff development efforts. Do you have any comment regarding this feature of the project?

Comments:

18. At the beginning of this project, it was decided that the entire teaching staff would participate either as credit students or as participants in the professional development aspects. Do you have any comment to make regarding this feature of the project?

Comments:

19. As part of this project, we met about 13 times over a period of seven months for a total of about 35 hours. Do you have any comments to make regarding the frequency, spacing or duration of these meetings?

Comments:
20. The planning and conducting of workshops was done by a team made up of four people: the principal, vice-principal, and two UBC staff members. Do you have any comments to make regarding this feature of the project?

Comments:

21. The workshops often contained a "hands-on" science activity. To what extent was this a helpful part of our meetings?

☐ a great extent
☐ some extent
☐ very little
☐ not at all

Comments:

22. The workshops sometimes included discussions of issues or concerns related to the teaching of science. To what extent was this a helpful feature of the project?

☐ a great extent
☐ some extent
☐ very little or none

Comments:

23. The workshops sometimes included descriptions and discussions by teachers of their own recent classroom science experiences. To what extent was this a helpful feature of these meetings?

☐ a great extent
☐ some extent
☐ very little or none

Comments:
24. This project did not begin with a detailed, preconceived plan or topics or activities. Instead, topics and activities were planned in response to concerns and issues brought forward by participants. Do you have any comment to make regarding this feature of the project?

Comments:

25. Some of our workshop time was devoted to individual or small group lesson or unit planning. To what extent was this feature useful to you?

☐ a great extent
☐ some extent
☐ very little

Comments:

26. Dr. Carlisle and Ms. Brooks were available on Thursdays to visit teachers and classes. To what extent was this feature useful to you?

☐ a great extent
☐ some extent
☐ very little or none
☐ I did not participate in this feature of the project (please comment below if you selected this response)

Comments:

27. In summary, to what extent was this a worthwhile project for you?

☐ a great extent
☐ some extent
☐ very little or none

Comments:
28. What, in your view, were the main strengths of this project?

Comments:

29. What, in your view, are changes that should be made if a project like this is to be conducted again in the future?

Comments:

30. Do you have any further comments you would like to make?

Comments:
APPENDIX B

HANDS-ON WORKSHOP ACTIVITIES

October 6  The Black Box:
A physical metaphor for science constructed by a former education student for Gaalen Erickson, a UBC professor. It is a closed wooden box, approximately the size of a large bread box, painted black, with a funnel going into the top and a short hose emptying into a beaker at the bottom. A series of 100 ml beakers of plain tap water are poured into the funnel; the water streams out of the bottom, first blue, then green, then red, and finally clear. Observers draw diagrams to portray what might be the inner workings of The Black Box.

October 6  Cartesian divers:
A 2 L polycarbonate "pop bottle" is filled with water and tightly capped. A 5 ml clear glass eye-dropper with black rubber cap is filled with just enough water to allow it to float vertically at the surface of the water in the bottle. When the bottle is squeezed, the eye-dropper sinks to the bottom of the bottle; the eye-dropper returns to the surface when the bottle is no longer squeezed.

October 20  Candle-in-the-jar:
A candle is fixed to the bottom of a shallow pan, and the pan partially filled with water. After lighting the candle, the student inverts a jar over the candle and lowers it to rest on the bottom of the pan and watches what happens.

November 3  Egg-in-the-bottle:
A piece of paper is set aflame and dropped into a milk bottle. A peeled hard boiled egg, slightly larger than the mouth of the bottle, is quickly placed to cover the mouth of the bottle and students watch what happens.
November 3  Magnets challenge (from the 1991 British Columbia Science Assessment project):
Students are given three magnets of the same size and mass but differing in strength, and asked to find which magnet is strongest. They are provided with materials: washers, nails, steel rods, steel balls, a spring balance, plasticene, and a ruler.

January 5  Magnets challenge, continued

January 19  none (unit planning)

February 2  none (unit planning)

March 2  Water box:
Three holes are made with a hot nail in the side of a 2 L pop bottle, at three different levels. The holes are plugged with plasticene and the bottle filled with water. Students predict the shape of the water streams that form when the plasticene is removed, and what will happen when the bottle is refilled and tightly capped.

March 16  Challenges from the Innovations in Science textbook series:
"Swing Time"
   Make a pendulum that makes one swing in one second.
"Staying on Top"
   Design a water strider.
"The Great Ice Cube Race"
   Melt an ice cube as quickly as possible.
"Bubbling Over"
   Test which brand of soap will make the best bubble.
"Slow Down"
   Make a piece of paper fall through the air slowly.
"Roll, Bottle, Roll"
   Predict and test which bottle will roll fastest.
"Layered Liquids"
   Observe items dropped into layers of water and oil.
"Marking Time"
Make a water timer.
"Worm Watch" (an open-ended activity created by workshop presenters)
Design your own challenge, using worms.

April 6  12 evaluation stations from the 1991 British Columbia Science Assessment project.

April 20  "Engineering for Children: Structures"
An APASE (Association for the Promotion and Advancement of Science Education) module of a series of engineering challenges that engage children in learning more about structural engineering.

May 4  none (planning science professional development for 1994-95)