A PROFESSIONAL DEVELOPMENT MODEL

BASED ON

INTERRELATED PRINCIPLES OF TEACHER LEARNING

by

Garry Hoban

Bachelor of Arts (Biological Sciences), Macquarie University, 1976
Graduate Diploma of Education, Macquarie University, 1976
Master of Education (First Class Honours), Charles Sturt University, 1993

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

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Abstract

This study explored the value of a professional development model and identified issues to be considered when using the model in a secondary school setting. The design of the model was based on three interrelated principles to support teachers in: (a) developing an awareness of their beliefs, (b) considering alternative perspectives from colleagues and their own students, and (c) generating a community learning environment to promote interplay between the principles of awareness and alternatives. This model guided the organization of a professional development program for three secondary science teachers over a period of two and a half years.

Two research questions were addressed in the study: (1) How did the teachers understand their practice and in what ways did their understanding change as a result of the professional development program? and (2) What features of the professional development program influenced change in the teachers’ understanding of their practice? As a result of the program there was a substantial change in how the teachers understood their practice. The teachers identified five common features of the program that enhanced this change: (a) personal reflections, (b) student tapes, (c) group discussions, (d) experimenting with their practice, and (e) feedback on their ideas. These features were consistent with the above three principles and were represented in models of their own learning, but not in the same configuration as in the proposed professional development model.

Two strengths of the professional development model are evident from the study. First, the model provides an organizational framework to support teachers in sustained knowledge-building within their community. Second, the model is underpinned by a theoretical basis for teacher learning relating individual and social influences on knowledge construction. This basis is consistent with a social constructivist perspective on learning and with Dewey’s (1938) theory of learning through experience. Issues to consider when using the model center on the ethical concerns of students disclosing information about their learning experiences and the need for collegiality to encourage teachers to share ideas. The main implication of the study is that organizers of professional development programs should not only consider each principle of teacher learning, but the interrelationship between them to provide teachers with opportunities for sustained knowledge-building.
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CHAPTER 1

INTRODUCTION

I. Background for the Study

Research over the last 20 years has provided valuable insights into how children learn. Many studies support a constructivist perspective emphasizing the influence of children's prior understandings on the way they construct meaning (Driver, 1983; Driver & Oldham, 1986; Erickson, 1979; Faire & Cosgrove, 1988; Fensham, 1988; Gunstone, 1990; Osborne & Wittrock, 1983; Osborne & Freyberg, 1985), while others have focused on the influence of classroom learning environments (Brown, 1994; Brown & Campione, 1994; Cambourne, 1972, 1988; Fraser, 1986, 1989). But what is the broader effect of this research in classrooms? According to Bell (1993), there was little change in teaching after findings from three major research projects on children's learning were disseminated to teachers in various forms:

A growing concern throughout the nine years of research was the limited impact of the research findings on teachers' and students' activities in the classrooms, despite evaluations indicating the effectiveness of the new approaches, their inclusion in new curriculum policy documents and the publication of a range of teachers' guides. (Bell, 1993, p. 3)

This raises a fundamental issue—learning opportunities for children in schools are restricted by the learning opportunities of their teachers. For example, if teachers are expected to organize classroom learning based on the notion of an active community of inquiry, then they need to experience similar learning opportunities in their own professional development (Quartz, 1995). This issue, however, is often neglected as schools are organized primarily for the development of children. Sarason (1990) has discussed this issue arguing that the two main causes for the continual failure of educational reform are existing power structures and the inadequacy of schools as learning environments for their staff as "teachers cannot create and sustain the conditions for the productive development of children if those conditions do not exist for teachers" (1990, p. xiv).
So what opportunities exist to support teacher learning in schools? In
most cases these opportunities are in the form of professional development
programs based on models which are designs to support teacher learning
(Sparks & Loucks-Horsley, 1990). Most of these professional development
models can be categorized into one of three groups according to the source/s
of knowledge used—outside-in, inside-in, and inside/outside—which
influences how the programs are organized. Outside-in models emphasize
knowledge that others generate for teachers and programs are organized to
present these ideas. For example, workshops based on a training model of
professional development often promote context-free formal knowledge
generated by educational researchers anticipating that teachers can apply this
in their practice. In contrast, inside-in models emphasize the knowledge that
teachers have generated from their own experiences and encourage them to
further investigate their ideas. For example, teachers are encouraged to reflect
on their practice and experiment with their ideas to generate further
knowledge about their setting. The third group, inside/outside models,
emphasize teachers sharing the practical knowledge they have generated
from their experiences in light of information from others to promote
"building knowledge in the community" (Cochran-Smith & Lytle, 1993, p. 52).
For example, teachers are encouraged to conduct research to gain a better
understanding of their practice and to consider alternative views in order to
encourage a community of discourse.

The consideration of alternative views by teachers in these
collaborative communities is an important issue, because it relates to notions
that they are generating knowledge as a "claim to know is a special type of
claim, different from a claim to believe and requiring justification in ways
that beliefs do not" (Fenstermacher, 1994, p. 30). In studies involving
inside/outside models, a variety of sources have been used to provide
teachers with alternative perspectives on their practice. These include
educational research introduced in context with teachers' beliefs (Bell &
Gilbert, 1994; Richardson, 1994a), the views of other teachers and student-
teachers (Cochran-Smith & Lytle, 1993; Darling-Hammond, 1994; Grossman,
1994), and the views of teacher educators working collaboratively with
teachers (Baird & Mitchell, 1986; Baird & Northfield, 1992; Fullan, 1993;
Mitchell & Erickson, 1995). However, an alternative perspective for teachers
exists within the school context but is rarely included in the ongoing discourse about teaching practice—views from their own students. Cherryholmes (1988) suggests that teachers should involve students in critical discourse in an attempt to evaluate practice and reconstruct their communities using an approach he called “critical pragmatism.” However, existing power structures in classrooms often militate against students directly offering praise or criticism about the practice of their teachers (Sarason, 1990).

II. The Study

**Purpose of the study**
The professional development model that is the focus of this thesis was constructed as a result of a 12 month pilot study conducted in a secondary school in Australia from June 1992 to June 1993. The initial purpose of this pilot study was to explore the use of a learning environment in year 9 science classes based on a general framework of social conditions for learning in a community (Cambourne, 1988). Interviews with the students were conducted several times throughout the pilot study to ascertain their views on learning science. At the end of 11 months, three workshops were held after school with other science teachers to share findings from the study. One of these workshops involved listening to some of the student interviews describing their learning in science compared to other subjects. This brief professional development program, however, resulted in disappointing evaluations from those teachers not involved in the previous 11 month study. It was clear that the teacher who had participated in the original research appreciated the workshop content more than those who had not. All the teachers, however, identified the student interviews as a positive feature of the workshops that provided them with an alternative perspective on how they understood their classroom practice. As a consequence of my reflections on the workshop evaluations, I decided to focus my research interests on teacher learning. Subsequently, I constructed a professional development model with the goal of assisting teachers to learn about their own practice and to support them in any directions for change that they proposed.
The design of the model was based on three interrelated principles to support teachers in learning about their own practice by: (1) developing an awareness of their beliefs through personal reflection on their teaching experiences; (2) considering alternative perspectives when sharing their ideas with colleagues in light of interview comments from their own students describing influences on their positive and negative learning experiences; and (3) generating a community learning environment based on the notion of social conditions for learning in a community (Cambourne, 1988) to promote interplay between the principles of awareness and alternatives. A diagram representing the model showing a relationship between these three principles of teacher learning is shown below in Figure 1.

Figure 1. Proposed Professional Development Model
The purpose of the main study was to explore the value of the professional development model shown in Figure 1 and to identify issues to be considered when using the model in a secondary school setting. This model guided the organization of a professional development program for a different group of secondary science teachers in another school for two and a half years from June 1993 to December 1995. Figure 2 shows a timeline for the pilot and main studies.

![Timeline for the Pilot and Main Studies](image)

**Figure 2. Timeline for the Pilot and Main Studies**

**Research method and design**

The main study was set in the context of a small rural high school 240 km from Sydney, Australia. Three male teachers, who constituted the entire science department at the school, participated in this study. Each teacher was in his second year at the school and had taught for a different length of time—one teacher was in his second year of teaching, another in his fifth year of teaching, and the head of department had taught for 14 years.

Three case studies were constructed focusing on the influence of the professional development program on each teacher's understanding of his practice. Data were collected over a period of two and a half years using a variety of methods. During the first 12 months of the study when I was in Australia, these data gathering methods were used: (a) informal conversational interviews, (b) student interviews to support teacher reflection, (c) teacher survey, (d) diagrams sketched by the teachers, (e) my own research diary, and (f) student interviews towards the end of the first year of the program to ascertain if any change in their science teacher's practice was noticed. During the next 18 months of the study when I was overseas, these data gathering methods were used: (a) teacher survey, (b) a general interview with specific questions, (c) audio-tapes of teacher meetings, (d) electronic-mail, and (e) diagrams sketched by the teachers representing models of their learning accompanied by personal statements to describe their models.
Research questions and method of analysis

In this study, learning was defined as teachers changing their understanding of their practice and so this needed to be monitored during the study. Barnes (1992) contends that it is useful to consider secondary teachers' understanding of their practice in terms of related beliefs or preconceptions that influence how they construct their work. In order to change their understanding of their practice, teachers need to become aware of their existing beliefs and reflect upon alternative views of classroom practice “to discover that their existing frame for understanding what happens in their classes is only one of several possible ones, and this, according to Schön, is likely to be achieved only when the teachers themselves reflect critically upon what they do and its results” (Barnes, 1992, p. 17).

In this study I am interested in ascertaining the influences that shape how teachers understand their practice and the effect of the professional development program on their understanding. This leads to the first research question:

1. How did the teachers understand their practice and in what ways did their understanding change as a result of the professional development program?

I will ascertain how the teachers understand their practice by analyzing how they describe their practice and identify the preconceptions or beliefs that support their understanding. In particular, I will be attentive to five preconceptions or beliefs central to teaching that Barnes (1992) contends are the most influential for how secondary teachers understand their practice: (a) their beliefs about subject matter, (b) their beliefs about student learning, (c) their beliefs about students, (d) their commitment to teaching, and (e) their beliefs about the priorities and constraints inherent in their context. I will use these five beliefs or preconceptions as categories for organizing data collected during the study to analyze if the teachers changed their understanding of their practice as a result of the professional development program.

If the teachers changed the way they understand their practice, I was interested in ascertaining what they considered to be the features of the
program that may have influenced this process. This leads to the second research question:

2. What features of the professional development program influenced change in the teachers’ understanding of their practice?

During the study teachers were asked to comment on features of the program that enhanced or constrained their understanding of their practice. In addition, each teacher was asked at the end of the program to sketch and explain a diagram that represented the relationship between features of the professional development program that enhanced how they understood their practice—in other words a model of their own learning during the program. In the case studies I compare features identified by the teachers to principles in the proposed professional development model shown in Figure 1.

Contribution of the study

This study has the potential to contribute to the research literature in several ways. First, this study may provide insights into influences that shape how teachers understand their practice. Second, the study may provide insights into the process of how teachers construct knowledge and how a professional development model may support this process. In particular, the study may highlight principles that influence teacher learning and provide a platform for further research to substantiate these principles. Furthermore, this study will explore the potential of using student data as an alternative perspective for informing the way teachers understand their practice.

Delimitations and limitations of the study

In this study there were several delimitations that narrowed the scope of the study. First, this study focused on teacher learning as a result of the professional development program. Although the use of student data was intended to assist teacher reflection, there was no concerted effort to evaluate student learning that may have resulted from any change in the teachers’ instruction. Accordingly, it is impossible to say that any change in teachers’ understanding of their practice was actually beneficial for their students. Second, I had particular views concerning learning at the beginning of the study, especially regarding conditions for learning, that influenced not only
how I constructed the model but also the way student data were collected, analyzed, and collated onto audio-tapes. My understanding of these conditions also influenced the way I interacted with the teachers during the study, such as when I provided my views about teaching and learning in context with the topic of discussion. Hence, a staff developer with another understanding of learning would possibly interact differently with the teachers.

The main limitation of the study was that there were no systematic classroom observations to monitor change in the teachers' practice. Hence, claims from the study are limited to statements referring to teachers' understanding of their practice. Second, data were collected intermittently during the study and so it was not possible to make claims about any change in teachers' understanding of their practice that occurred beyond the data collection sessions. However, a variety of data gathering methods were used during the study to provide different forms of data regarding the teachers' understanding of their practice. Third, a limitation of the study was related to my dual role as researcher and staff developer. On one hand, this assisted implementation of the model as I understood it, but it created difficulties when trying to move beyond my own perspective as I interpreted data. However, I was overseas for the last 18 months of the study and relied on the teachers sending me diagrams and descriptions of their views on their own learning. Furthermore, an educational researcher who had previously not been involved in the study conducted teacher interviews in December 1994, after I had been overseas for six months. Finally, the three case studies represent my interpretation of data collected over the two and a half years for each teacher. The teachers, however, participated in three member checks during the study to monitor my interpretations of data. In particular, each teacher read his case study and wrote a response to my interpretations as well as reading and commenting on the last chapter.
III. Motivation to Conduct this Study

In this study I attempted to ascertain influences that shaped how teachers understand their practice. Consequently, I will provide a brief personal history that shaped my motivation for conducting this study. I was very successful in my primary and high school education. I was always one of the top five students in my year and did very well in my final year 12 exams winning three different scholarships to university. I selected the scholarship to be a science teacher because I thought this job would enable me to use my social skills to assist young people to reach their potential, and I liked science as a subject having gained a high grade in that subject in my final exams (First Level Physics).

Contrary to my secondary school experiences, I was not very successful in my science degree at university, just managing to scrape through my first year classes. Upon reflection many years later I realized the reason. I rote-learned most of my high school work and did not have a clear understanding of major science concepts to provide a sound basis for university studies, especially physics and chemistry. Nevertheless, I continued in my university degree majoring in biology because I could still use my rote-learning ability in that subject. I only achieved minimum grades, but that did not concern me at the time for two reasons. First, I had a scholarship to be a teacher so I was guaranteed a teaching appointment as long as I achieved passing grades. Second, I remember being disappointed at the quality of teaching displayed by my university lecturers in both my education and science degrees. In science, lectures generally involved detailed note-taking about facts being presented followed by practical classes to verify the lecture content. Rarely was there any exciting investigation involved; it was learn the content from lectures, follow the instructions in practical classes, and write about it in exams. Nevertheless, my rote-learning of biological facts managed to get me through my science degree so that I could really do what I wanted to do—teach in a secondary school. Also, my education subjects at university did not inspire me very much either. There didn’t seem to be much connection between what we did in school on our practicum and what we did in our education classes. When I started teaching full-time this view was reinforced by other
I never worked so hard as I did in my first two years of teaching. Apart from having three junior secondary science classes, I also taught two senior biology classes. I had to retrace much of the content that I supposedly learnt at university to get an understanding of the knowledge so I could teach it. Eventually, I taught secondary science for 14 years in five different secondary schools and would classify myself as a successful teacher—I was selected from state-wide applicants to teach at the Royal Australian Airforce School in Penang, Malaysia; was promoted when I returned to be head of a high school science department; and later was selected to be a K-12 Regional Science Consultant. On reflection, however, I realized that my teaching style replicated the way I was taught at school and university. My teaching was driven by my understanding of subject matter with the intention that students would accumulate knowledge in years 7-10 to provide them with a foundation for learning science in years 11 and 12. And I did this in a very linear manner. I organized my lessons so that students would be given sections of content that I assumed they would connect with the occasional practical experiment to verify what I was telling them—the teacher initiates, the student responds, the teacher verifies model. Ironically, I did not realize at the time that I was replicating in my secondary science classroom the style of teaching that I found so boring at university.

My views on teaching began to change when my wife, a primary teacher, and I attained teaching positions in the outback of New South Wales, Australia. I was the head of a science department in a small rural high school but spent a good deal of time assisting isolated primary teachers at one-room schools to teach science. This involved collaborating with them to design science modules for use in their K-6 classrooms, the implementation of which was the topic for my M. Ed. (Hons.) thesis. It was during this time that I took a particular interest in the way they taught other subjects as well. I got the sense that primary teachers were not so fixated on teaching facts as

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1 Practicals are experiments or "labs" conducted in high school science laboratories that usually last one lesson.
secondary teachers appeared to be and were more flexible in their approaches to support student learning. My experience in assisting K-6 teachers with their science instruction resulted in my employment at a university in an education faculty coordinating science method classes for early childhood and primary preservice teachers. I have spent six years in this position which involved my own inquiries into how young children learn and visits to classrooms to supervise beginning teachers on their practicum. What I saw in many classes were children actively learning through their own investigations supported by class discussions, thematic approaches to learning, and caring teachers. During this time I took a special interest in the way language, written and spoken, influences learning. Also, I kept reflecting on how the primary teachers taught compared to how I taught in secondary school. After a while it became clear to me that I was pedagogically naive as a high school teacher—I knew my science content, but very little about how children learn.

What puzzled me for quite a while is why I had such a simplistic view of learning during my 14 years as a secondary science teacher? I think there were two reasons. First, I remember being in my initial year of teaching and organizing my lessons to get as much subject matter across to the students as possible. I thought that this was the sign of a good teacher. Also it enabled me to control the students better if I kept them busy. And when I consider how my understanding of student learning was reflected in the organization of my lessons to teach subject matter, it was an easy decision—I didn’t really have one. No doubt learning was a major topic in my education classes at university, but I didn’t understand it. I just divided my science knowledge into teachable blocks and thought of practicals that would support the ideas I was trying to get across. This approach seemed logical to me; it was how I was taught at school and university. Second, this method of teaching fitted in with the programs and assessment procedures at the schools where I taught. So, I was a classic example of two well known phrases about teachers—teachers teach as they are taught (Lortie, 1975) and secondary teachers teach subject matter not children (Sarason, 1990).

But as I consider all the science teachers that I know, I wonder how different they are from me? Having investigated aspects about learning over
the last five years, I now have some firm beliefs. My views on learning are based on the assumption that it is a process conducted by individuals but this process is strongly influenced by social interactions with those around you. In addition, I believe that the key to quality teaching at any level is an understanding of student learning. In other words, the teaching of subject matter should be adapted to the process of learning, not vice versa. Hence, my motivation for this study is based on the hope that the teachers will gain a better understanding of their practice by listening to views about learning from their own students. The intended outcome is that teachers who have an improved understanding of their students’ learning will be better teachers.

IV. Organization of the Chapters

This thesis is organized into eight chapters that fall into two main sections. The first three chapters document how views from the literature and research conducted during a 12 month pilot study contributed to the construction of a professional development model. The remaining five chapters explain how I explored the value of this professional development model and identified issues to be considered when using the model in a secondary school setting.

Chapter 2 is a review of the literature to position this study in the field of teacher professional development. I begin the chapter by discussing forms of teacher knowledge and examine the strengths and limitations of three groups of professional development models—outside-in, inside-in and inside/outside models—that support teacher learning.

Chapter 3 outlines how I constructed a professional development model based on three principles of teacher learning as a result of my reflections on my 12 month pilot study. It begins with a brief review of literature to identify social conditions that support learning that seem to be helpful in establishing a learning environment of a community. It was these conditions that were initially explored in the pilot study to assist student learning but later became relevant to my ideas for teacher learning.
Chapter 4 explains the research methods that I used in the main study to address the two research questions. Furthermore, this chapter outlines procedures for collecting and analyzing data regarding teacher learning and data from students to inform teachers about their practice. This chapter concludes with a discussion of ethical issues involved in this type of professional development, as I am intervening in teacher-student power relationships when interviewing students about influences on their positive and negative learning experiences.

Chapters 5, 6, and 7 provide a case study for each teacher. Data collected during the study are presented to address the two research questions. Each chapter concludes with a diagram provided by each teacher that represents a model of his own learning during the program accompanied by the teacher’s explanation of the model.

Chapter 8 provides an overview of the research findings across the three case studies. This is followed by a discussion concerning the purpose of the study leading to conclusions that are related to the research literature. The thesis concludes with a discussion of implications for practice from the study and suggestions for further research.
CHAPTER 2

REVIEW OF THE LITERATURE

Overview
This chapter provides a context for the study. In the first section I discuss different forms of teacher knowledge and the process of knowledge construction to inform the second part of the review of literature. In this next section I provide an overview of different professional development models and categorize them into three groups according to the source/s of knowledge used—outside-in, inside-in, and inside/outside models—to inform teachers about their practice. The strengths and limitations of these professional development models are discussed including the different forms of evidence used to assist teachers in knowledge construction.

I. Forms of Teacher Knowledge

Various forms of teacher knowledge have been described that underpin the way teachers construct their practice. One of the early researchers in this field was Elbaz (1983) who identified five categories that supported a teacher’s practical knowledge: knowledge of self, knowledge of the milieu of teaching, knowledge of subject matter, knowledge of curriculum development, and knowledge of instruction. Inquiries into teacher knowledge have also led to alternate research methodologies such as narrative inquiry that highlight teachers’ stories to illuminate their “personal practical knowledge” (Clandinin, 1985; Clandinin & Connelly, 1987, 1996). Other terms for teacher knowledge have also been used such as propositional knowledge, case knowledge, and strategic knowledge (Shulman, 1986), local knowledge and public knowledge (Cochran-Smith & Lytle, 1993). Shulman (1987) also identified categories of teacher knowledge—content knowledge, general pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners, knowledge of educational contexts and knowledge of educational ends—that could be used as a basis for teacher accreditation. In all, Richardson (1994a) recently noted that 26 different terms have been used to describe forms of teacher knowledge.
Several authors have attempted to group these many forms. Grossman (1990) identified four general areas of teacher knowledge: (a) general pedagogical knowledge that includes beliefs and knowledge related to learning and learners, general principles of curriculum and instruction, classroom management, and the aims of education; (b) subject matter knowledge that includes knowledge of facts and concepts in a field, and knowledge of structures of a discipline; (c) pedagogical content knowledge that includes the knowledge and beliefs about the purpose for teaching a subject, knowledge of students' understandings, curricular knowledge, and knowledge of instructional strategies for teaching particular topics; and (d) knowledge of context that includes knowledge of students, school, families and communities. In particular, she highlights the importance of pedagogical content knowledge as influential in shaping how secondary teachers construct their work, as it refers to knowledge that is pertinent to teaching their area of speciality. The sources that contribute to this pedagogical content knowledge include a teacher's "apprenticeship of observation" (Lortie, 1975), their discipline degree, educational coursework such as methods courses in their education degree, and learning from experience.

Fenstermacher (1994) took an epistemological approach to grouping forms of teacher knowledge by categorizing them into two types—formal knowledge and practical knowledge—based on who generates it. He described formal knowledge as a "justified true belief" based on Gettier's (1963) three conditions for a knowledge claim that "S knows that p, if and only if (i) p is true; (ii) S believes that p, and (iii) S is justified in believing that p" (p. 121). Hence, a proposition or belief becomes formal knowledge if there is rigorous evidence for a premise, and a community of professionals within a discipline agree on the procedures for developing the argument and conclusions (Richardson, 1994a). Usually, formal knowledge is generated by educational researchers and "it appears in standard or conventional behavioral science research. . . . the process-product studies of teaching are perhaps the most well-known instance of this form of knowledge" (Fenstermacher, 1994, p. 6).

On the other hand, Fenstermacher (1994) explained that practical knowledge is related to Schön's (1983) epistemology of practice and generated
by teachers when “participating in and reflecting on action and experience. This is bounded by the situation or context in which it arises” (1994, p. 12). Hence, practical knowledge is a justified belief and contextual to a setting whereas formal knowledge is a justified true belief and has relevance for other contexts. Accordingly, he argued that practical knowledge as a justified belief does not need to be agreed upon as "true" by a community of professionals, but as a form of knowledge needs to be submitted to a process of justification:

If the potential of the notion of practical knowledge, knowledge-in-action, personal practical knowledge, or teacher knowledge is to be realized, all who would study it face an obligation to take seriously the fact that they are studying notions of knowledge and, as such, must work through matters of warrant and justification (Fenstermacher, 1994, p. 49)

For example, Fenstermacher (1994) contends that the minimal form of warrant to justify a practical knowledge claim is for the holder of the belief to provide a practical argument, meaning good reasons to an observer for doing or believing something.

These procedures for justifying beliefs are dependent on evidence that legitimates a claim as knowledge. Scheffler (1965) highlighted this feature when discussing the three conditions necessary for the establishment of propositional knowledge: (a) the belief condition, (b) the truth condition, and (c) the evidence condition. In particular he emphasized the importance of the third condition referring to the term "adequate evidence":

It serves to distinguish genuine knowing from mere true belief, by reference to appropriate evaluation of the belief by the believer: the surplus strength of knowing consists, in short, in the knower's having adequate evidence for the belief in question. (Scheffler, 1965, p. 56)

"Adequate evidence", therefore, means good reasons or a good case to know something, implying a judgment\(^1\) about evidence by the believer based on the way he/she understands evidential data and "appreciating their value as

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\(^1\) The moral dimension of knowledge as a justified true belief has been explored in *The Moral Base for Teacher Professionalism* (Sockett, 1993).
data, in the light of an appropriately patterned argument" (Scheffler, 1965, p. 70). Using evidence to justify a belief as knowledge is similar to Toulmin’s argument pattern that uses a warrant to authorize the establishment of conclusions from data (Toulmin, 1958). In particular, evidence that justifies a claim as knowledge is called a knowledge warrant and has value for the believer called “backing” that gives authority to the warrant. This procedure is represented in Figure 3.

Belief  

<table>
<thead>
<tr>
<th>justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warrant (adequate evidence—believer understands and values evidence)</td>
</tr>
<tr>
<td>Backing (authority for warrant)</td>
</tr>
</tbody>
</table>

Figure 3. Argument Pattern for Establishing a Knowledge Claim  
(adapted from Toulmin, 1958)

However, consensus on justification is problematic, because there are different views on what counts as evidence leading to the “relative status of knowledge and practice” (Tom & Valli, 1990, p. 389). Nonetheless, not all views are equally deserving within a community and “something more is required before we can speak of knowledge (or even confirmation) as opposed to plausibility. One way to articulate the distinctions I am urging is to treat analysis of how hypotheses are generated and to treat analysis in the context of justification” (Longino, 1993, p. 102). In short, from an epistemological perspective there is a difference between beliefs and knowledge and procedures for justification are necessary to legitimate a knowledge claim (Fenstermacher, 1994; Gettier, 1963; Longino, 1993; Richardson, 1994a; Roberts, 1982; Scheffler, 1965). In the next section I examine various professional development models and discuss how they are organized to provide teachers with evidence to assist them in generating knowledge.
II. Professional Development Models

A professional development model is a "design for 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" (Sparks & Loucks-Horsley, 1990, p. 235). In this review of the literature I discuss these assumptions for different professional development models. First, I provide a brief overview of different criteria that have been used to categorize professional development models and then group them into three types according to the source/s of knowledge used—outside-in, inside-in and outside-inside. Although professional development models will be placed into these three groups, they are not mutually exclusive and models exist that integrate features across the three groups. Furthermore, I will discuss the strengths and limitations of each type for teacher learning.

Criteria for grouping professional development models

Different criteria have been used to categorize professional development models. For example Gilbert (1993) divided professional development models into two approaches based on different views about how the education of teachers relates to the wider society. She described a technicist/functional approach which assumes that knowledge can be divided into discrete entities and taught separately. Consequently, professional development becomes a process of training teachers to acquire parts of knowledge and skills which they need to make sense of and apply to their teaching. In contrast, a critical approach to teacher development assumes that learning occurs in a social context incorporating a dialectic between teachers and society (Vygotsky, 1986). In this respect teachers are viewed as intellectuals who reflect upon and determine their own practices in the context of a changing world.

Other writers have used criteria concerning who instigates and controls the professional development process to group models. Cole and Theissen (1991) divided forms of staff development into two groups based on who conducts them. The first group involved programs conducted by teachers within schools: individually (writing, self-evaluation, teacher as researcher and individually guided practice); in pairs (teachers as colleagues, coaching
and mentoring); and in groups (support groups, action research teams and school improvement initiatives). The second group involved programs conducted for teachers within and across organizations; in support systems (institutes, short courses, teacher leadership positions and instructional supervision); in centers (teacher centers, research and professional development centers and professional development schools); and in partnerships (school-university, networks, and organizational cooperatives). Similarly, Richardson (1994b) divided staff development into these two groups based on who controls the agenda and the process but added a third group which is a mixture of the other two—collaborative programs in which there are two or more interested individuals or groups who control the process. Eraut (1994) recently discussed various professional development models stating that they need to incorporate “the use of theoretical and practical knowledge in some kind of dialogical relationship, involving close linkage between off-the-job reflection and ongoing classroom experience” (p. 5968). He described four professional development models that attempt to address this need: (a) Joyce and Showers’ approach to skill development, (b) reflective models that often incorporate an action research component, (c) project-based models, and (d) personal professional development opportunities.

It should be noted, however, that these categorizations refer to planned learning experiences for teachers and often there are subtle unplanned learning experiences that teachers engage in every day. In short, teachers regularly make meaning of their experiences according to taken-for-granted assumptions that influence how they interpret ongoing events around them (Barnes, 1992). In some cases this is similar to Schön’s (1983) notion of reflection-in-action in which teachers make on-the-spot decisions based on seeing an experience in a different way. Another example of unplanned learning relates to Lortie’s (1975) notion of “apprenticeship of observation” referring to the deep-seated beliefs that teachers generate from their personal histories that influence how they interpret their experiences in their everyday working situation. The resilience of beliefs about teaching generated from an individual’s experience as a student in school have been supported in several studies (Grossman, 1991; Lortie, 1975). In particular, a study by Anning (1988) found that teachers’ theories of children’s learning were consistent with the
way they believed they learned in their own school education. In the remaining review of the literature, I discuss the strengths and limitations of planned teacher learning as guided by professional development models and categorize them into three groups based on the source/s of knowledge used. This is an important way of grouping professional development models because the source/s of knowledge used influences how they are organized.

A. Outside-in models

Outside-in professional development models emphasize knowledge that has been generated by others for teachers to use in their practice. These models support the conventional role of educational researchers who work outside of a school context producing knowledge for teachers inside schools (Lytle & Cochran-Smith, 1994) as represented in Figure 4.

Figure 4. Representation of Outside-in Professional Development Models

* Arrow in this diagram denotes attempted transfer of knowledge

A rationale for this approach is that teachers as a community tend to reproduce existing practice and need to be informed by educational theory to
provide alternative perspectives on teaching and learning (Hatton, 1988). As the role of educational researchers is to generate new knowledge about teaching and learning, it is common to use formal knowledge as the content for professional development programs to inform teachers about new ideas. The best example of outside-in models is the training staff development model which exists in several forms.

**Training staff development model**

The strengths of this model are that new knowledge is presented to teachers that is often beyond their existing experiences and this can be disseminated in a convenient way. Consequently, programs based on this model are organized to disseminate new knowledge or skills to teachers with the presenter being the expert who controls the content and organization of the workshop/workshops. In most cases, the focus of a workshop is to present evidence of good practice that has been justified as propositional knowledge by the academic community. For example, the content of workshops can focus on such areas as teachers acquiring new disciplinary knowledge, approaches to new curriculum, or skills concerning conflict resolution (Hord & Boyd, 1994), ideas about learning styles (Samples, Hammond & McCarthy, 1985), new technologies or cooperative learning (Johnson, Johnson, Holubec, & Roy, 1984). Sparks and Loucks-Horsley (1990) explain that workshops are beneficial because they promote practice deemed to be worth replicating that is beyond the regular experiences of teachers:

> 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 classroom that were not previously in their repertoire. (1990, p. 241)

There are a range of ways in which training courses can be organized to present knowledge to the teachers according to the degree of follow-up support. For example, workshops may vary from one-shot sessions to multiple sessions to provide follow-up support. Moreover, some workshops commence with discussions concerning experiences of the participants that are relevant to the course content. Joyce and Showers (1988) argue that the success of a training program depends on its design and is related to the
consideration of five components that "maximize probability that the desired
effects will be achieved" (1988, p. 68):

- **exploration** of theory including discussions, readings or lectures in
order for the participants to understand the theory being promoted;

- **demonstration** or modeling of the desired skill in the form of
videotape or live in a setting that can be integrated with explanations
of theory;

- **practice** of the required skill under simulated conditions to
approximate the workplace that needs to occur twenty or twenty-five
times depending on the complexity of the task;

- **feedback** on the required skill from peers or experts following practice;

- **coaching** in the workplace following initial training involving a
supportive community of teachers to provide support and collegiality
during the learning process.

There are several limitations for teacher learning, however, in the
training professional development model. First, the five components
identified by Joyce and Showers (1988) do not take into account the context of
a particular school before the training and the resistance of teachers' beliefs to
ideas that are not consistent with their regular practice (Fullan, 1991).
Furthermore, an assumption that underpins this model is that teachers will
accept the knowledge being presented as adequate evidence (Scheffler, 1965).
In this regard, it is assumed that teachers will understand the formal
knowledge being presented such that it is meaningful to them and value it as
an authoritative source of information for their practice.

In summary, there are several strengths of outside-in models for
teacher learning. First, they provide alternative views on teaching practice
that are often beyond teachers' existing experiences. Second, it is a
convenient and economical way to disseminate new knowledge because
teachers can gather at a venue and be provided with the content over a brief
period of time. In addition, the topic of workshops may resonate with teachers' existing beliefs or focus on an area that the teachers are interested in learning more about. In both of these cases, it is likely that the ideas from the workshop may be readily understood and assimilated into their existing practice. Moreover, training workshops provide opportunities for teachers to interact with colleagues from other schools although this may not be the primary intent. However, limitations of the model are that in most cases teachers' existing beliefs and the school context are not taken into consideration, and there is often little follow-up support to promote change in existing practice.

B. Inside-in models

Inside-in professional development models emphasize the knowledge that teachers have already generated from their own experiences and encourage them to reflect and explore their ideas based on these understandings. Hence, these models are controlled by teachers as they experiment with their own ideas in their context. These models do not seek a perspective from outside of the teaching community and hence involve teachers inside a school setting exploring ideas in their own context as represented in Figure 5.

![Diagram of Inside-in Professional Development Models](image)

Figure 5. Representation of Inside-in Professional Development Models
* Arrows denote research conducted in the school context
A key aspect for teacher learning underpinning inside-in models is personal reflection to assist teachers to become more aware of how they understand their practice (Baird, Fensham, Gunstone, & White, 1991; Dewey, 1933; Grimmell & Erickson, 1988; Hatton & Smith, 1995; Munby & Russell, 1992; Schön, 1983, 1988). According to Baird (1992), reflection is the basis of teacher learning, “If learning is a constructivist process by which the learner generates meaning according to what he or she already knows and believes, it follows that reflection is a cornerstone of learning and of personal and professional development” (p. 39). There are four types of inside-in models which vary according to the extent that teachers participate with colleagues in their professional development. These four models have been described by Sparks and Loucks-Horsley (1990) although they did not group them as inside-in models.

1. Individually guided staff development model

The strength of this model is that it encourages individual teachers to take control of their learning by designing a personal plan. Examples include teachers experimenting with new instructional strategies that they have devised, visiting other classrooms, devising personal growth plans (Burnaby School Board, 1990), and studying new instructional materials (Hord & Boyd, 1994). This process usually has four phases: (i) identification of a personal need or interest, (ii) development of a plan to address the need or interest, (iii) the learning activity, and (iv) assessment. Sparks and Loucks-Horsley (1990) provide three assumptions that underpin this model which refer to the individual as a self-directed learner and consider the source of knowledge about teaching to be determined by the individual. They write:

that individuals are capable of self-direction and self-initiated learning and that they can best judge their own learning needs. It also assumes that adults learn most efficiently when they initiate and plan their learning activities, rather than spend their time in activities that are less relevant to them than those they would design. . . . The model also holds that individuals are most motivated when they select their own learning goals on the basis of personal assessment of their needs. (Sparks & Loucks-Horsley, 1990, p. 235)

A limitation, however, of this model is that it may not include an alternative perspective to challenge existing assumptions and so “risks turning into an
unreflective reproduction of ongoing practice” (Cherryholmes, 1988, p. 90). Other inside-in models, however, provide an alternative perspective by inviting teachers to collaborate in their professional development.

2. Observation/Assessment staff development model

This model is different from the individually guided model because it usually involves teachers working in pairs to provide an alternative view on classroom instruction. Examples of programs include peer coaching, clinical supervision (Acheson & Gall, 1980), and teacher evaluation. Some of these programs are based on Madeline Hunter's approach whereby specific behaviors are monitored by using a checklist or observational chart. This often involves a “buddy system” where teachers are grouped in pairs to observe and provide feedback to each other. The usual phases in this model include a pre-observation conference to determine the focus for the session, time spent in class while the observer collects data, and a post-observation conference in which data are presented and discussed. Sparks and Loucks-Horsley (1990) describe four assumptions that underpin this model that refer to the teacher as a reactive learner and regard the source of ideas being within the teachers' experiences:

Observation and assessment of instruction provide the teacher with data that can be reflected upon and analyzed for the purpose of improving student learning. A second assumption is that reflection by an individual on his or her practice can be enhanced by another's observations. . . . Another assumption is that observation and assessment of classroom teaching can benefit both involved parties—the teacher being observed and the observer. . . . A final assumption is that, when teachers see positive results from their efforts to change, they are more apt to continue to engage in improvement. (1990, p. 237)

In many cases, the model involves phases and it is anticipated that in the post-observation discussions, the teacher will be able to make sense of the feedback on the nominated behavior and assimilate any changes into his/her teaching practice. A limitation of this model, however, is that teachers may view this model as a form of evaluation and so may be reluctant to participate in these programs (Wise & Darling-Hammond, 1985). Furthermore, although this model encourages discussion among teachers, the feedback needs to be
considered in light of other factors such as the disruption of having an observer in class (Guskey, 1994).

3. Development/Improvement staff development model

This is another collaborative model involving teachers working in a team to develop their own school-based curriculum or school improvement program. In this way the process of teachers collaborating and making decisions about curriculum is a form of professional development, as it involves teachers discussing ideas that underpin their practice. Typically there are five sequential phases in these programs: (a) identification of a problem or goal, (b) action plan developed (c) implementation, (d) analysis, and (e) evaluation. An assumption related to the teacher learning embedded in this model is that learning involves social interactions as teachers engage in negotiations to address problem-centered tasks seeking information on a need-to-know basis. According to Glatterhorn (1984), if teachers cannot be involved in a complete curriculum development process, then there are three other ways in which they can participate: by taking the objectives and designing instructional strategies with activities, developing the curriculum by designing extension modules, or by adapting the curriculum to suit children with special needs. This model also underpins programs which focus on school improvement whereby teachers participate in a decision making process to address their own school needs (Hord & Boyd, 1994).

Sparks and Loucks-Horsley (1990) state that there are three assumptions that underpin this type of staff development model which refer to teachers as proactive learners as well as providing their own source of knowledge about teaching. In addition, there is a consideration of other factors that influence learning such as understanding the context for making decisions:

One assumption on which this model is based is that adults learn most effectively when they have a need to know or a problem to solve (Knowles, 1980). ... Another assumption of this model is that people working closest to the job best understand what is required to improve their performance. ... A final assumption is that teachers acquire important knowledge or skills through their involvement in school-improvement or curriculum-development processes. (1990, p. 239)
This model emphasizes teachers sharing ideas about a problem—that is salient to their context. However, the range of ideas often depends on the variety of perspectives of different teachers.

4. Inquiry staff development model

The purpose of this model is for teachers, individually or collectively, to learn by formulating their own questions and to investigate them by gathering and analyzing data from their own classrooms. The feature of this model for generating knowledge is that the teachers are involved in a process of investigation and collecting data about their own context. In this regard, it is likely that teachers will value and understand evidence gathered as they are responsible for the design and implementation of the investigation.

The best example of this model is action research that promotes the notion of teacher-as-researcher. This movement originated in the work of Lewin (1946) and was encouraged by Stenhouse (1979) who argued that teachers should become curriculum researchers and developers. Examples include individual or group action research projects to investigate student learning strategies, studying learning styles in one's own class, and exploring the use of a new instructional strategy (Carr & Kemmis, 1986; Hord & Boyd, 1994). Often action research involves a continuing spiral of cycles consisting of four major parts—planning, acting, observing and reflecting:

The basic assumption is that learning is experiential and reflective—that is, people can learn and create knowledge on the basis of their concrete experiences, through observing and reflecting on that experience, forming abstract concepts and generalisations, and testing the implication of these concepts in new situations, which will lead to new concrete experience and hence, the beginning of a new cycle. (Zuber-Skerritt, 1993, p. 46)

Sparks and Loucks-Horsley (1990) list three assumptions that underpin this model of staff development that refer to the teacher as a proactive learner and the source of knowledge about teaching being within a teacher's experience:

(a) teachers are intelligent, inquiring individuals with legitimate expertise and important experience; (b) teachers are inclined to search for data to answer pressing questions and to reflect on the data to
formulate solutions; and (c) teachers develop new understandings as they contribute to and formulate their own questions and collect their data to answer them. (1990, p. 243)

Carr and Kemmis (1986) contend that “action research rejects positivist notions of rationality, objectivity and truth in favor of a dialectical view of rationality” (p. 179). In this regard, action research links reflection to action to generate knowledge about practice. Action research, however, has been criticized if it leads to simple answers to solve problems as “action research too easily slips from thoughtful reflection on experience into a rationality of problem thinking and problem solving” (van Manen, 1990, p. 155). This may be the case if action research is conducted individually, as collaborative investigations are more likely to provide an enriching experience because of the contribution of ideas from a variety of perspectives.

In summary, there are several strengths of inside-in models for teacher learning. First, they encourage teachers to be responsible for their own learning and to value their ideas based on evidence collected within their context. Second, they are consistent with a constructivist perspective on learning that encourages teachers to be reflective practitioners (Schön, 1991). A limitation, however, for teacher learning using inside-in models is that it is likely that teachers will interpret their experiences based on the way they already frame their practice. This is more likely to occur if teachers work in isolation and do not collaborate with other teachers to provide them with alternative perspectives.

C. Inside/Outside models

These professional development models emphasize both the knowledge that teachers have generated from their experiences and the knowledge of others to promote a “community of discourse” (Cochran-Smith & Lytle, 1993). There are two aspects of teacher learning underpinning these models—personal reflection by the participants and the introduction of alternative views to provide participants with different perspectives on teaching and learning. Consequently, teachers' inside perspectives are complemented by teacher research from inside and educational researchers' and other outside perspectives. Features common to these models include
shared control of the agenda and the contribution of ideas from participants with a rich variety of perspectives. A diagram representing the relationship between teachers and university educators and researchers in such a community is shown in Figure 6.

![Diagram of Inside/Outside Professional Development Models]

Figure 6. Representation of Inside/Outside Professional Development Models

* Arrow denotes research

Although these models provide platforms for integrating ideas from theory and practice, a limitation is that they take a great deal of time and effort to not only establish these collaborations, but also to maintain them, as there are often differences between the university and school cultures (Bickel & Hattrup, 1995; Goodlad, 1993; Stoddard, 1993).

There are two types of inside/outside models, one focusing on the professional development of preservice teachers and another for practicing teachers although these two audiences often overlap.
(i) Inside/Outside model for preservice teachers

This model focuses on the education of preservice teachers but often incorporates the professional development of accredited teachers. Some are large scale such as The Learning Consortium involving four school districts and two universities around Toronto, Canada (Fullan, 1993). This large scale collaboration focuses on sharing information about learning for 13,700 teachers, 230 faculty, and students in 500 schools. Although this consortium has initiated many collaborative projects, sometimes there has been friction among interest groups due to their different agendas. Other examples of this model are much smaller and include professional development schools that provide a variety of ways in which teachers and teacher educators collaborate to redesign both teacher education and the practice of teaching (Pasch & Pugach, 1990; Yinger & Hendricks, 1990). Darling-Hammond (1994) reported that school-based interactions in professional development schools between teachers, teacher educators, and novice teachers enables knowledge to be constructed in a variety of ways:

- knowing through direct action and reflection, as well as by understanding and appreciating the findings of others
- knowing through sharing different experiences with colleagues
- knowing through research conducted by teachers along with researchers that is informed by the diverse experiences of individual children as well as the aggregated outcomes codified in empirical studies. (Darling-Hammond, 1994, p. 15)

These interactions involve building knowledge by negotiating the relationship between two different kinds—the formal research-based knowledge promoted in teacher education courses and context-based knowledge that is the basis for much practice in schools. For example, Grossman (1994) discussed how preservice teachers, teachers, and teacher educators at Lara Creek Middle School in Washington State, USA, collaborated to address the goals of outcome-based education. This involved an interdisciplinary core seminar taught in the school (replacing four courses—general methods of teaching, crucial issues in education, educational psychology, and educational evaluation) to discuss educational issues in context with students' field experiences. Furthermore, the student
teachers were assigned to experienced teachers within the school to regularly interact with them like a mentor.

A similar example involved student teachers collaborating with teachers to conducting research in a school setting (Cochran-Smith, 1993). Groups such as Project START based at the University of Pennsylvania involve student teachers on year-long student teaching experiences meeting weekly with cooperating teachers, university-based supervisors, project directors and teacher educators to discuss their experiences and examine the assumptions that underpin practice. In order to generate knowledge, student teachers participate in action research projects and write personal narratives and critical essays to “link the student teacher’s emerging understandings to empirical and conceptual research in education and other fields” (Cochran-Smith, 1995, p. 501).

(ii) Inside/Outside model for practicing teachers

This differs from the previous inside/outside model, as it focuses on the professional development of practicing teachers. For example, The Philadelphia Writing Project (PhilWP) is part of the National Writing Project aiming to foster a writing-across-the-curriculum initiative in schools. Members of the community include K-12 teachers, university teachers, school administrators and adult literacy practitioners (Lytle & Cochran-Smith, 1994). This project involves summer and year-long institutes with the participants researching, discussing and writing about the investigations for the generation of both local and public knowledge. Cochran-Smith and Lytle (1993) describe a range of ways for teachers conducting research to gather data about their particular context. These include empirical research using journals, oral inquiries and classroom/school studies or conceptual research using essays which draw upon teachers’ experiences and assumptions that underpin their practice.

Another example of a school/university community is the Project for Enhancing Effective Learning (PEEL) in Australia in which collaborative

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3 Project START (Student Teachers as Researching Teachers) is a year-long school experience as part of a masters degree for elementary teachers.
action research was used as a methodology for research by teachers and teacher educators (Baird, Mitchell, & Northfield, 1987). The goal of the group was to generate teaching strategies to foster “good learning behaviors” in students and procedures to address their “poor learning tendencies” (Baird & Northfield, 1992). This involved regular meetings of teachers and academics working together to investigate classroom learning and “through weekly meetings and continual informal contact, the teachers and consultants celebrated successes, commiserated with failure, shared insights, and gained strength to try again” (Baird, Mitchell, & Northfield, 1987, p. 132). Baird (1992) identified three guiding principles to support these forms of collaborative enquiries: (a) converge processes and outcomes in teaching, learning and research; (b) support change by providing adequate and appropriate time, opportunity, guidance, and support; and (c) base personal and professional improvement on reflection.

A different type of inside/outside model involved the explicit use of formal knowledge as an alternative perspective to justify teachers’ beliefs about their practice (Richardson, 1994a). In the Reading Instruction Study, a staff developer videotaped a teacher’s lesson followed by a meeting to view the tape together. At certain stages the teacher is asked to provide a rationale for a particular action and this discussion may become the platform for the explication of a practical argument (Fenstermacher, 1994). An alternative view on the teacher’s practice based upon a formal knowledge perspective is provided in the conversation by staff developers. In this type of setting, formal knowledge is introduced in context with their beliefs and is likely to be understood by the participants. Moreover, the skills of the staff developer are important because the new knowledge needs to be introduced in a way that teachers appreciate its relevance to their instruction without devaluing their existing practice (Richardson, 1990). Another long term program involved teachers exchanging ideas about their practice in light of current research on children’s learning (Bell & Gilbert, 1994). This three year research project on teacher development had two aspects—the input of new theoretical ideas with discussions, and the "trying out", evaluation, and practice of these ideas with follow-up sessions to encourage critical reflection. The significant teacher development that occurred was not due to one feature, but related to
an interaction of the personal, social, and professional components of the program.

In summary, there are several strengths of inside/outside models. First, they involve an interaction between knowledge that teachers have and alternative perspectives which may be in the form of formal knowledge or different points of view. Often these collaborations involve participants conducting research in the particular context to be later reviewed in group discussions. Furthermore, professional development programs based on this model are usually long term involving regular meetings of the participants. Possible limitations, however, center on the needs of the different interest groups because of their different agendas, and it takes a good deal of time and effort to establish and maintain such community discussions.

One group of stakeholders in schools, however, is rarely included in these community discussions in inside/outside models. The views of students on how teaching influences their learning is a perspective from inside the school context but often outside regular teacher discourse about their practice. Although teachers regularly receive feedback from students in the form of minor test results or pupil observations, this feedback often focuses on what they are teaching, not necessarily how they are teaching. Furthermore, there are often constraints that limit students providing more structured feedback to teachers on their practices because of the asymmetrical power relationships that dominate classroom discourse:

Classroom interactions are fundamentally asymmetrical because of the teacher’s authority. Teachers are authorities by virtue of their position because they are contractually obligated to provide instruction, to evaluate student progress, to assign grades, and to follow administrative directives. Teachers are also authorities because of their expertise resulting from greater education, training, and experience. Teacher authority militates against symmetrical interactions.

(Cherryholmes, 1988, p. 169)

Nevertheless, the use of students’ views is a source of evidence that provides teachers with a different perspective on their practice. Furthermore, this is contextual evidence that may foster reflection by teachers and question the assumptions that underpin teachers’ understanding about their practice.
(Hargreaves, 1996; van Manen, 1977, 1990). This argument is consistent with ideas promoted by Cherryholmes (1988) suggesting that teachers, as a community, should consider critical views on their practice so as to rethink what they say and do and be "concerned with evaluating and constructing the communities, educational and otherwise, in which we live and work" (1988, p. 14). Key to this process is criticism of existing discourse and practice, not by comparing beliefs with other teachers who hold similar views or with educational theory, but requiring teachers to "share the norms of critical discourse with students" (Cherryholmes, 1988, p. 169). The purpose, however, of this juxtaposition of the voices of teachers and students is not based on a critical theory to emancipate teachers or students but such "rethinking may rejuvenate commitment to conventional discourses-practices or it may lead to something quite different" (Cherryholmes, 1988, p. 153). In the next chapter I explain how an outside/inside professional development model highlights the use of students' views on their learning as an outside perspective on the practice of their teachers. In addition, I discuss conditions that support a community learning environment which is important to encourage interactions necessary to sustain teacher learning in inside/outside professional development models.

**Summary**

In this chapter, professional development models were grouped according to the source/s of knowledge used: outside-in models that focus on knowledge generated by others to present to teachers; inside-in models that focus on teachers exploring their own knowledge; and inside/outside models that encourage ongoing discussions based on teachers' knowledge in light of ideas from alternative perspectives. Table 1 summarizes this overview of professional development models identifying strengths and limitations of each type of model. In the next chapter I describe how a professional development model was constructed to encourage teachers to reflect and share their experiences in light of interview comments from their own students discussing influences on their learning. In particular, I focus on the conditions to establish a community learning environment that is a key principle of the professional development model.
<table>
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<tr>
<th>Professional Development Group</th>
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<th>Knowledge Source</th>
<th>Strengths</th>
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<td>4. Controlled by participants</td>
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CHAPTER 3

CONSTRUCTION OF A PROFESSIONAL DEVELOPMENT MODEL

Overview

The purpose of this chapter is to outline how my reflections on the outcomes of a 12 month pilot study in a secondary school informed the construction of a professional development model that was explored in the main study.1 This model is consistent with inside/outside models discussed in the previous chapter. Although the original goal of the pilot study was to explore the notion of a community learning environment to support student learning, this focus changed to teacher learning as a result of the pilot study.

The chapter is presented in four sections. First, I discuss the importance of sharing ideas in a community by focusing on the notion of social conditions to promote interactions based on the work of Cambourne (1972, 1988) and Dewey (1897, 1901, 1938). Second, I describe how I conducted an 11 month pilot study with a secondary science teacher to explore the potential value of trying to simulate these conditions to assist student learning in year 9 science classes. In the part three of the chapter, I describe the second stage of the pilot study involving three after school workshops with other science teachers at the school to share our findings. Conflicting evaluations of these workshops led to the conceptualization of a teacher professional development model based on three interrelated principles of teacher learning. In short, this chapter highlights critical incidents in my thinking that changed the focus of my research from exploring a learning environment for high school students to exploring a learning environment for high school teachers.

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1 Most of the information reported in this chapter is documented in my research journal that I kept during the study.
Several studies have identified common features of successful learning communities. Darling-Hammond (1994) highlighted ten characteristics of successful professional development schools first identified by Van de Water (1989): mutual self-interest and common goals, mutual trust and respect, shared decision making, clear focus, manageable agenda, commitment from top leadership, fiscal support, long-term commitment, dynamic nature, and information sharing and communication. Many of these features are consistent with Senge's (1990) components of a learning organization: systems thinking, personal mastery, mental models, building a shared vision, and team learning. Similarly, Bereiter and Scardamalia (1993) described characteristics of "knowledge-building communities" such as academic research centers, high-technology industrial laboratories, and some families: a desire to participate, new information produced from research, sustained period of engagement, inquiry is driven by questions not facts, participants are encouraged to produce their own theories involving mutual respect for the ideas of members, focus is toward collective goals of understanding rather than individual learning, participants often work individually but on related projects; other sources of evidence are pursued, and a range of experience among members. Furthermore, in a review of literature on communities of teachers, Placier and Hamilton (1994) identified four common conditions: positive working conditions, autonomy, motivation and freedom to change, and a community of practice leading to collegiality.

What is common among these four descriptions of successful learning communities is the notion of sharing ideas described as "shared decision making, information sharing and communication" (Darling-Hammond, 1994), "shared vision and team learning" (Senge, 1990), "collegiality" (Placier & Hamilton, 1994), and "collective goals of understanding and judgement" (Bereiter & Scardamalia, 1993). Yet this feature of sharing ideas, central to any community, is often missing from many school settings. Hargreaves, (1994) recently described secondary schools as "balkanized" suggesting that teachers are split by powerful boundaries related to subject identities that "restricts professional learning and educational change among communities of teachers" (p. 235). In addition, it has been argued that embedded school
cultures can sometimes oppose such notions as collaborating in a community, “the conditions of work in schools spawn and continually reinforce teacher privatism, isolation and a strong sense of individualism” (Sparkes, 1989, p. 9). In spite of these difficulties, however, there is an increasing number of successful school learning communities as described in the previous chapter (Baird & Mitchell, 1987; Cochran-Smith & Lytle, 1993; Darling-Hammond, 1994; Grossman, 1994; Richardson, 1994). But what are the conditions of a community learning environment to encourage the sharing of ideas?

Two authors, Brian Cambourne (1972, 1988) and John Dewey (1897, 1938), identified social conditions to encourage interactions and the sharing of ideas in a community. Both observed settings that highlight social influences on learning—young children learning in a family community. Cambourne (1972) conceptualized his understanding of learning by studying the interactions among participants of family communities that support young children learning to talk:

If they are to become functioning members of the culture, newly born members of any society must learn how to make meaning using the same language conventions that the rest of the community uses. This involves the internalization of literally thousands of items of knowledge about the sound system, the vocabulary, the grammar and the social uses of language. . . . Although the nature of the family unit may differ from culture to culture (and has differed from age to age), there are certain core features which seem to be constant across time and cultures. These core features are as follows. Young learners are always in close proximity to proficient users of the language. Furthermore, among these proficient users (the ‘experts’) there is usually at least one with whom the learner forms a significant bond. Most probably there is a range of ‘experts’ of different degrees of language proficiency with whom bonds can be formed. There is a community of ‘user experts’. Within this framework there are certain conditions present which contribute to the learning processes which take place. (Cambourne, Butler & Turbill, 1991, p. 17)

In such a setting, young children are continually exposed to a mature practice—talking—within the context of a family, usually are motivated to communicate, and are encouraged to participate in the practice by socially interacting with family members.
John Dewey (1897) also based his ideas for learning on the notion of a community as an alternative to the dualism between traditional education, that emphasized teacher directed delivery of prescribed content, versus progressive education, emphasizing student directed freedom of inquiry. Similar to Cambourne (1988), many of Dewey's ideas about learning in schools were based on the setting of young children learning in a family:

If we take an example of an ideal home, where the parent is intelligent enough to recognize what is best for the child, and is able to supply what is needed, we find the child learning through the social converse and constitution of the family. There are certain points of interest and value to him in the conversation carried on: statements are made, inquiries arise, topics are discussed, and the child continually learns. He states his experiences, his misconceptions are corrected. . . . Participation in these household tasks becomes an opportunity for gaining knowledge. . . . Now, if we organize and generalize all of this, we have the ideal school. There is no mystery about it, no wonderful discovery of pedagogy or educational theory. It is simply a question of doing systematically and in a large, intelligent, and competent way what has for various reasons can only be done in most households only in a comparatively meager and haphazard manner. (1900/1990, p. 34-35)

In contrast to Cambourne (1988), however, Dewey (1897) argued that learning by young children in a family community involved psychological influences as well as social assuming that the individual is the unit of analysis:

For instance, through the response which is made to the child's instinctive babblings the child comes to know what those babblings mean; they are transformed into articulate language and thus the child is introduced into the consolidated wealth of ideas and emotions which are now summed up in language. I believe that this educational process has two sides—one psychological and one sociological; and that neither can be subordinated to the other or neglected without evil results following. Of these two sides, the psychological is the basis. The child's own instincts and powers furnish the material and give the starting point for all education. . . . Without insight into the psychological structure and activities of the individual, the educative process will, therefore, be haphazard and arbitrary. . . . I believe that knowledge of social conditions, of the present state of civilization, is necessary in order properly to interpret the child's powers. (Dewey, 1897, p. 4)
Dewey's perspective on learning involving a psychological basis influenced by social factors was reiterated 41 years later in *Experience and Education* (1938). He argued that education is a social process and that schools should be organized based on the notion of a community emphasizing "the principle of learning through personal experience. The solution of this problem requires a well thought-out philosophy of the social factors that operate in the constitution of individual experience" (Dewey, 1938, p. 21). Cambourne's and Dewey's views on the social conditions that influence learning in a community are explained in the next section followed by Dewey's views on individual considerations.

**Social conditions for learning in a family community**

Cambourne (1988) identified eight social conditions to promote a community learning environment that supports children learning to talk:

(a) *Immersion:* Children are immersed in the medium of language and culture of a family that provide them with a context for their learning. It is the common knowing of this code of meaning that allows children to participate in family activities.

(b) *Engagement:* Children are surrounded by opportunities to learn all the time, but sometimes choose not to do so. He argued that engagement is more likely to occur if learners see a task as achievable, that there is an authentic purpose for the attainment of that task, that it is a low risk environment, and that there is a caring relationship among the participants.

(c) *Demonstrations:* Whilst immersed in the context of a family community, children receive examples of the mature practice—talking. This knowledge is shared in a family by children imitating, and following the practice of others.

(d) *Expectations:* Cambourne explains that expectation to learn needs to be evident from the perspective of both the child and others involved in the practice. In this way family members expect children to talk and children are encouraged to achieve this task.
(e) **Responsibility**: Children need to take ownership and make decisions to control their own learning.

(f) **Practice**: Children need time and opportunities to try out their ideas to develop their understanding. If children are practicing their language, they will need to take risks to experiment with their ideas and learn by trial and error which is encapsulated in this and the next condition.

(g) **Approximation**: Children experiment with their language and make mistakes by trial and error.

(h) **Feedback**: Children receive feedback from family members on their efforts which corrects their errors and improves their subsequent level of participation.

In short, Cambourne identified eight social conditions that support children learning to talk in a family community. One condition refers to the context—*immersion*; four refer to the role undertaken by each learner—*responsibility, approximation, practice*, and *engagement*; and three refer to the role undertaken by the mature family members—*demonstration, expectation*, and *feedback*. It should be noted that it is the combined influence of these conditions that supports non linear holistic learning.

In describing the learning environment of a community, Dewey also believed that it consisted of social conditions that encouraged interactions to support individual learning. In his essay, *Education as a Social Function* in chapter two of *Democracy and Education* (1916), he explained the influence of the environment on individual learning:

> The environment consists of the sum total of conditions of all the activities of fellow beings that are bound up in carrying out the activities of any one of its members. The social environment consists of all the activities of fellow beings that are bound up in the carrying on of the activities of any one of its members. (p. 22)

In particular, he outlined conditions of the social environment of a community that influences "the way in which a social group brings up its
immature members into its own social form” (1916, p. 10, emphasis in original). These social conditions influence conscious and unconscious learning resulting from interactions between young children and mature community members:

(a) *Demonstrations:* Dewey stated that mature community members provide examples of desirable behaviors similar to a role model by “setting up conditions which stimulate certain visible and tangible ways of acting as the first step” (Dewey, 1916, p. 14). The example Dewey provided was a young child learning war like activities in a primitive tribe.

(b) *Expectations, Demands, Approvals and Condemnations:* As young members interact with mature members in a community they receive “the expectations, demands, approvals, and condemnation of others. A being connected with other beings cannot perform his own activities without taking the activities of others into account. For they are indispensable conditions of the realization of his tendencies” (Dewey, 1916, p. 12). Accordingly, as young members interact with other members of the community they will receive feedback as praise or criticism on their efforts to guide individuals in their participation.

(c) *Participation:* Community members conduct joint activities when they share experiences such that an immature member of the community “shares or participates in the common activity” (Dewey, 1916, p. 13). The example Dewey provided was young children interacting with adults when learning to talk in a family community.

(d) *Engagement:* Dewey stated that the social environment of a community influences the behavior of individuals by involving them in purposeful learning and “engaging them in activities that arouse and strengthen certain impulses, that have certain purposes and entail certain consequences” (1916, p. 20). The example that Dewey provided was a young child becoming musically inclined whilst growing up in a family of musicians.
In an earlier essay, *Psychology and Social Practice* (1901), Dewey identified other conditions that referred to the role of learners in developing "intellectual and moral progress and power" (p. 12). Accordingly, he argued that similar to adult learning, children should be allowed more "personal responsibility for determining what is relevant" (1901, p. 14) which he claimed is possible with the presence of three conditions—*personal selection*, *personal application* and *personal experimentation*. These conditions for learning, however, are often denied to children at school because of a formal curriculum:

No one seriously questions that, with an adult, power and control are obtained through personal selection of means and materials which are relevant, and through personal adaptation and application of what is thus selected, together with whatever experimentation and of testing is involved in this effort. Practically every one of these three conditions of increase in power for the adult is denied for the child. (Dewey, 1901, p. 13)

Taking into consideration both of Dewey's articles (1901, 1916), he identified ten social conditions for learning. Five of these refer to the role of the learner—*personal selection*, *personal application*, *personal experimentation*, *participation*, *engagement*; and five refer to the role of experienced members—*expectations*, *demands*, *approvals*, *condemnations*, and *demonstrations* to encourage social interactions in a community.

A comparison between Dewey's and Cambourne's social conditions for learning in a community is presented in Table 2. There is a strong similarity which is not surprising as they conceptualized their ideas about learning based on a similar setting (young children learning in a family community), for a similar purpose (to identify the conditions to promote social interactions that support learning) and assumed the same unit of analysis (the individual within a learning environment).
Table 2. Comparison of Dewey's and Cambourne's Social Conditions for Learning

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<td><strong>Role of the Learners</strong></td>
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<tr>
<td>• Engagement</td>
<td>• Engagement</td>
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<tr>
<td>• Responsibility —Personal Selection</td>
<td>• Responsibility</td>
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<td>—Personal Experimentation</td>
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<td>—Personal Application</td>
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<td>• Participation</td>
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<td><strong>Role of the Experienced Members</strong></td>
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<tr>
<td>• Expectation</td>
<td>• Expectation</td>
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<tr>
<td>• Approvals, Demands, Condemnation</td>
<td>• Feedback</td>
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<td>• Demonstration</td>
<td>• Demonstration</td>
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<td><strong>Context</strong></td>
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<td>• Immersion</td>
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Both Cambourne (1988) and Dewey (1916) stated that although their conditions were identified from an environment that supports young children's learning, they are not specific to young children. In short, they argued that these conditions are applicable to support the learning of older children and adults based on the notion of a community. Dewey contended that the greatest obstacle to certain educational reform was "the assumption of a fundamental distinction between child psychology and the adult psychology where in reality identity reigns, viz., in the region of the motives and conditions which make for mental power" (Dewey, 1901, pp. 10-11). His message was reiterated three years later stating that "there is no psychology of the schoolroom different from that of the nursery, the playground, the street, and the parlor" (1904, p. 18).

\(^2\) It should be noted that Cambourne's conditions were originally called "conditions for natural learning". In communications with Cambourne he stated that "conditions for learning in a community" was a better phrasing as shown in Appendix A.
Individual influences on learning

Dewey's view on the psychological aspect of learning was encapsulated in his theory of experience describing individual learning as "a continuous process of reconstruction of experience" (Dewey, 1938, p. 87). Also, Dewey argued that experiences become meaningful when they are compared to previous experiences stored in an individual's mind or intelligence. These new experiences then add to the mind's store for comparison with future experiences to produce knowledge:

Experience begins when intelligence projects something of itself into sensations. . . . The experience as an existence, as a clustering of sensations, is already there. The sole thing is to find out what it means, and this can be done only as there is supplied the mediate relational ideal factor. The growth of the power of comparison implies not a formal growth, but a synthetic internal growth. It implies that when the mind is stimulated to an act of comparison, it has a more varied, complex, better organized system of ideas or meanings to bring upon its sensations, and thus to transfer to these its own content of significance. This transference evidently incorporates the given experience into the system of meanings or of intelligence, and thereby the better prepares the latter for future apperceptive acts; its incorporation adds to the synthetic content of intelligence, and thereby to the meaning of possible future experiences. The process of the growth of experience is accordingly a reciprocal one. Any experience has meaning as the self projects this meaning into it from its own ideal store; this projection appropriates the given experience, as to its meaning, into the ideal store of the self, thereby farther developing it. Knowledge might be indifferently described, therefore, as a process of idealization of experience, or of realization of intelligence. (1887/1969, p. 396)

In short, Dewey was arguing that interpretations of experiences get stored in the mind of an individual and that new experiences become meaningful when there is a comparison with previous experiences. Accordingly, his theory of learning through experience was based on two principles—continuity and interaction. By continuity he meant that "the experiences already had . . . provide the starting point for all further experiences" (1938, p. 74) implying that teachers should organize learning to provide subject matter in context with these experiences. Related to this was "the principle that development of experience comes about through interaction means that education is essentially a social process. This quality is realized in the degree
in which individuals form a community group" (1938, p. 58). Hence, learning should start with the experiences of the individual and are reconstructed by interacting with others in the learning environment of a community.

I contend that Dewey’s notion of experience as previously outlined foreshadowed what is currently called a constructivist view of learning. A key element of a constructivist perspective is that knowledge is actively stored in the mind, “knowledge is not passively received but actively built up by the cognizing subject; the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality” (von Glaserfield, 1987, p. 37) and that learning occurs through the notion of personal meaning making that “transforms, organizes and interprets our experiences” (Fosnot, 1989, p. 19). This resonates with Dewey’s notion of learning through the reconstruction of prior experiences which are then stored in the individual’s mind for later comparisons. There are, however, differences in Dewey’s notion of experience to a constructivist perspective. Dewey talks about a “system of ideas” (1887/1969, p. 396) in the mind but he does not mention specific structures or cognitive models that constructivists would argue would assist in the interpretation of experiences:

Put simply, this perspective acknowledges that individuals construct ‘models’ or ‘schemes’ which are used to interpret experiences. . . . An individual’s knowledge, therefore, is not considered as a set of discrete ‘bits’ but a series of structures and learning involves the development of such structures. (Driver & Oldham, 1986, p. 107)

However, different from a radical constructivist perspective, Dewey always argued that education involves both social and psychological influences as “an experience is always what it is because of a transaction taking place between an individual and what, at the time, constitutes his environment. . . . The environment, in other words, is whatever conditions interact with personal needs, desires, purposes, and capabilities to create the experience which is had" (1938, p. 44). Furthermore, in a classroom it is the role of the teacher as the most mature member of the community to provide the conditions which promote interactions to link an individual’s ideas based on their previous experiences to subject matter:
There is incumbent upon the teacher who links education and actual experience together a more serious and harder business. He must be aware of the potentialities for leading students into new fields which belong to experiences already had, and must use this knowledge as his criterion for selection and arrangement of the conditions that influence their present experience. (1938, p. 76)

This is what Dewey (1902/1990) called "psychologizing" the subject matter such that subject matter has some "psychological meaning." This implies that teachers should consider what students know from their experiences and provide subject matter in context with those experiences such that a teacher "is concerned, not with the subject-matter as such, but with the subject-matter as a related factor in a total and growing experience" (1902/1990, p. 201).

Dewey's notion of learning involving the interaction between an individual's prior experiences and the conditions of the environment, especially the social conditions, are consistent with current views relating individual and social influences on learning (Cobb, 1994; Driver, Asoko, Leach, Mortimer, Scott, 1994). In this regard, Dewey's theory of learning though experience is consistent with a social constructivist perspective on learning. This view was also recently proposed by several educational researchers (Garrison, 1995; Prawat, 1995; Prawat & Floden, 1994). In the next section I will explain how social conditions for learning (Cambourne, 1988) that were similar to Dewey's (1901, 1916) conditions for learning in a community were explored in a secondary school classroom at the beginning of a pilot study. These same conditions later became relevant for teacher learning in a professional development model.
II. Pilot Study Part (i): Exploring Social Conditions for Learning in a Secondary Science Classroom

This 12 month pilot study occurred in two parts. For the first 11 months I worked with a secondary science teacher to explore the use of Cambourne's conditions for learning in his year 9 science classes. In the last month of the pilot study I organized three after school workshops for the other science teachers at that school. A timeline which indicates the major events in this pilot study is shown below in Figure 7.

The idea for this pilot study evolved from a discussion with a part time instructor of a science methods class in a Bachelor of Education course for primary teachers in Australia in May, 1992. There were six classes or sections in the course and the instructor, Greg, and I taught three classes each. I was the science education coordinator at the university and Greg was head of a science department at a local girls' high school. Both of us had extensive experience teaching high school science and had a sound understanding of the primary science curriculum. The discussion after the methods class centered on the way secondary science teachers often attempt to transmit science facts to students followed by practical classes to verify the content. We wondered if high school science could be taught using learning strategies evident in some primary classes. In addition, I had an interest in students using alternative forms of writing to assist their learning in science. We agreed that I should get some ideas together as a basis for a later discussion. I had previously seen primary teachers using a whole language approach in classrooms to support literacy learning and I was impressed by the social interactions between the teacher and learners. In Australia, this type of learning environment is often based on the work of Brian Cambourne,
Director of the Centre for Language, Learning and Literacy, University of Wollongong, NSW, Australia. He argues that a productive classroom learning environment can be organized based on the notion of conditions for learning that he identified from a setting that highlights social influences on learning—a family community supporting children learning to talk (Cambourne, 1972).

In September, 1992, Greg and I met at his high school to discuss how he could simulate Cambourne's conditions in his secondary science teaching. I interpreted Cambourne's conditions for learning for a secondary science context and presented a summary to Greg for discussion (see Appendix B). To address these conditions, students should learn in groups and be responsible for making decisions about problem solving tasks with the support from the teacher and other students. In this way, students need to be responsible for their ideas and be encouraged to experiment with these and receive feedback from their teacher and other students. After our discussions, Greg decided to try these ideas with his grade 9 class as he was about to teach the topic of "Communication." Also, since students were investigating their own ideas, I suggested that they be encouraged to write about them using an informal report style rather than using a conventional science format. At the time I provided him with some examples of students' writing from my wife's primary science class to demonstrate how students could write in this way to document the process of their investigations rather than using the conventional procedure of "problem, method, result, conclusion." He attempted to organize his teaching based on these conditions for learning and encouraged his year 9 students to document their ideas in their own words using the informal report style. He commenced the unit by showing the year 9 students examples of science writing from primary classes that I provided him. At the time the year 9 classes were rotating teachers and so Greg had the class for a six week block.

After he had taught two science classes for six weeks based on our discussions about Cambourne's conditions, he participated in an interview on November 29 1992, to discuss his views about this approach to teaching science. He explained that he had been looking for a new approach as he was
discontent with the conventional didactic way of teaching science by directing students in how to conduct their practical work and what results to expect:

Greg: For years, I've thought that, particularly with practicals and the way we do practicals, that we tell the kids what they have to do. We tell them exactly how to do it, we tell them what results they expect, we never make them think, we never expect them to think. And they're not really doing their science, they're doing our science and they're not really discovering things for themselves. Whenever things don't work, we start saying, "Oh, well, why, why, why?" And how can the kids tell us why it doesn't work when they haven't done the practical in the first place, we have.

Our discussions about the limitations of conventional science teaching encouraged him to give students more responsibility for their learning by conducting and writing about their own experiments. This involved giving them a task and encouraging them to devise their own procedures in groups. This was followed by children conducting their own experimentation with the help of the teacher:

Greg: I've been trying to destructure most aspects of the classroom, particularly the writing up and doing the practicals. So, instead of me doing what I call the traditional recipe approach, which seems to be our work not the kids' work, I've been asking them to write in a less formal way in their own words what they discover in practicals . . . Initially, I gave them a couple of samples of some writing from a primary school science class that showed them how you can write about science without having to have their own methods, results, but still maintaining a rigor that showed what they'd been trying to find out and what they'd done and what results they'd had and what they actually found out for themselves. So, within the less formal way, there are still areas that have to be covered but how the kids cover them is up to them rather than up to us . . . I've tended to set a lot more research style questions in the unit for homework. As a pre-practical exercise for example, one of the practicals was making paper, and they had to complete an assignment in the library before that where they looked at the history of paper and some of the techniques used.

An example of informal report writing in science from one of Greg's year 9 students is shown on the next page. This shows that students were devising
their own procedures for making paper in a group over a period of a week and documenting the process.

<table>
<thead>
<tr>
<th>on monday we added small pieces or ripped up paper to cold water and swished it around. It then put in detergent to wash the paper. It was then drained.</th>
</tr>
</thead>
<tbody>
<tr>
<td>On wednesday we put bleach on the paper until it was saturated. The paper was then drained again and washed with cleaner. The bleach. The water was squeezed out and blue dye was added to colour the paper. This was mixed with water to make it easier to put on the gauze. More gauze was put on the top to press it and it was left to dry. No one hoping the paper will dry like normal paper.</td>
</tr>
</tbody>
</table>
| The paper was left for 24 hours and is still damp. The gauze we used to press the paper has left rust marks. If I were to do this experiment again I would have put more dye in the water. I wouldn't have used newspaper. I and I would have either used something else to press the paper like two heavy objects or I would have cleaned the gauze thoroughly.

Figure 8. Sample of Report Writing in Science from a Year 9 Student.

At the end of the six week unit on 27 November 1992, I interviewed his year 9 students to ascertain their views on the way they had been learning in science. I thought that the students would be more comfortable discussing their views in a group so they were interviewed in three groups of 10 students. Two of the groups were interviewed before morning recess and a third group was interviewed after morning recess. The first two groups said that they liked doing science this way but were not explicit about their reasons. The third group were more forthcoming with their views about learning science.
By coincidence, one of the girls from the third group was hired by my wife a week later to babysit our children. She told me that the third group were more open with their views because the previous groups had discussed my interviews with them at morning recess and had agreed that it was "OK to be honest with me." In other words, they had decided to trust me with their opinions.

Students from the third group described how they had been learning science with Greg (Mr Auhl) over the previous six weeks. It was listening to their comments later that I noticed how they were highlighting examples of Cambourne's conditions for learning. For example, they talked about experimenting with their own ideas that is consistent with the condition of responsibility:

S1: It's up to us, we would write it out ourselves.
S2: He leaves it up to you to decide what to do, to work out what you had to do. He gives us an aim and then its up to us to do it, to figure out what to do. And then you learn more kind of thing.
I: Do you?
S2: Yeah, because you understand it more, you've got more time to explain it to anyone.
S1: And when you go to study it, it's in your words and so you know what you are talking about.

Also, the students were getting ongoing assistance from the teacher which is consistent with the condition of feedback:

S3: And you don't have to copy it from the board, so he's got more time to tell you about it.
I: Right. So he doesn't just sit there and read the paper?
S3: No, he comes around and talks to us and asks us what we are doing and gives us clues and explains things.
I: Right, so he might give you hint but does he say do this or try this?
S3: No, we work it out ourselves.

I will highlight several critical incidents in the pilot study that influenced my thinking to use student data for teacher professional development.
Furthermore, the students were using trial and error which is consistent with the condition of *approximation*:

I: So do you do the experiment once?
S 2: No, if you don't get it right the first time you have to keep going.
S 4: You play around with it until you get it right.
I: Is that better or worse than how you did it before?
S 4: Better, because then you know what works and what doesn't and so you have a better idea of what is actually going on.
S 1: You know what you need to make it work and stuff.

Later in the interview the students were critical of the way they did science in previous classes with another teacher. They claimed that they only did experiments once and were not allowed to experiment with their ideas. Furthermore, the teacher told the students what to write in their books to make sure that they had the right answers for tests:

I: So how did you normally do science like last year or the year before?
S 4: Aim, method, results, then conclusion.
S 1: I hated that, they gave you the aim, they told you what the results were supposed to be and if you didn't get it, well too bad.
S 3: You already knew what happened before you did it. So it was nothing new.
I: Did you write your own conclusion?
S 1: Yeah, but if you got it wrong you had to correct it and he gave us the right way of writing it.
I: What do you mean?
S 1: If you were unsuccessful with what you were doing, he wouldn't let you write down what happened, you had to write down the successful way which you wouldn't understand because you didn't have the chance to experiment with it.
S 6: Like you didn't have as much time to do it because you have to write up everything. By the time you finish it's the end of the lesson.
I: And you've got to have the right answer in your book?
S 1: So then you study it for the exam and you might get the right answer but you don't know how the hell you got it.

The students gave a specific example of how they conducted science in a previous topic, “The Periodic Table” with another teacher compared to the way they had been working with Greg. They explained that they often copied work into their books which they did not always understand. They found this frustrating as teachers would phrase the questions differently in tests:
SI: I wouldn’t compare it [the current topic] to “The Periodic Table” because that is totally irrelevant to life. I hated that topic. If you ask me it would have been easier to do this sort of thing in “The Periodic Table”. Even though it would have been a change, because in “The Periodic Table” all we got told was to write this down, and we never understood it and we were just told to write it down and we were suppose understand it.

S 1: I said to her once, not mentioning any names, I said that “I don’t understand that bit” which she had written on the board and she said “You do understand it because you wrote it down yesterday.”

S 3: Yeah, you just write it down, it’s not as if you are taking it in.

S 2: Teachers think that you do.

I: What do you do then?

S 2: You just write it down.

S 1: You don’t read it, they think you do, but you don’t.

I: What do you do?

S 5: It’s like letters, it doesn’t have any meaning to it, you are just making sure you get the right spelling.

S 3: Yeah, it’s just like writing single words.

S 2: And then you wake up and you sort of read it and think ohhhh!

S 4: Like when you study for a test you learn it word for word and then when it comes to a test they ask it in a different way and you won’t know it.

S 1: Like when you are writing it down in your own way you are thinking about what you are writing because you have to because you don’t have anything else to get it from, so you learn more.

CRITICAL INCIDENT 2
I listened to all the recorded student interviews with Greg later in the week. He and I discussed how honest and insightful the students were and how they were able to articulate the “game” of learning in secondary school. We also discussed how confronting or confirming it would be if the other teachers heard these comments. I realized very quickly how powerful views from students would be for teacher professional development—straight from the customer so to speak.

Greg based his science teaching on the same conditions for learning with his new year 9 class in the first few months of 1993. He allowed me to interview some of his students about their learning at the end of the unit on May 7 1993. Greg selected four students with the best grades in year 9 science to be interviewed which I recorded using a video camera. The students made
similar comments to the group that I had interviewed the previous year—that conventional science lessons usually involved getting knowledge from the teacher with little room for their own experimentation and interpretation. The key comments in these interviews centered on a comparison of the way they learn science in a conventional way compared to English. They all agreed that the subject in which they learned best was English because they can use their ideas to give their own interpretation. This was in contrast with science, because it was usually taught as a body of facts that they had to learn for tests:

Int.: Can you think of a subject where you best learn?
All: English.
Megan: It's because it is a lot of discussion.
Int.: So what are the features that make it good learning or easier to remember do you think?
Megan: You can be a bit more creative like science has been taken too much like the way it has to be. Like you can write things in your own words and then use the terminology, like terminology is important but if it is just terminology and it doesn't mean anything then you are not going to learn. Science is too structured.
Int.: What do you mean that science is too structured?
Emily: Like it is too set and everything is set and you can't bring new ideas into it. It is there, you just have to learn it.
Megan: It helps if you can interpret it.
Emily: Like in English you can create new things and put new things in of your own whatever, but with science you just learn it and that is all I think.
Int.: What do you mean how do you learn it?
Emily: You get told.
Int.: You get told what?
Megan: Like E=MC squared and what is E and what is M? You do have to be told but it is "This is that" and you just have to learn it.
Int.: You said that in English that you get to play around with your own ideas, is that a good way to learn?
Emily: Yeah, I think so.
Int.: Couldn't you do that in science too, you've got ideas haven't you?
Emily: Yeah, you could but I don't know, it wouldn't seem right sort of thing.
Int.: Why?
Emily: Everything is just so set. It is like someone saying "Well you can do this" but it just wouldn't be right. Like there are set laws sort of thing. Like you can bring your own ideas into it but there is always that set law.
Int.: So do you feel that you are going to be told the right answer anyway?
Emily: Yeah, you can play around with it as much as you like but it is still that one thing.
Mary: Like in English there are still rules but you can still play around with it to make it different. In science you can play around with it but it is wrong.

Later, Greg and I watched the video interview and he asked me if I could organize a professional development program for the other four science teachers on his staff at his school to share our investigations. I agreed and in the next section I describe the procedures and outcomes of the program.

III. Pilot Study Part (ii): The Professional Development Program

In May 1993, I organized workshops on three consecutive Wednesdays after school. The purpose of the program was to share the ideas that Greg and I had been exploring and in particular to discuss the influences of organizing a classroom learning environment based on Cambourne’s conditions for learning in a secondary science context. I thought that the best way to organize this was to ask the teachers to first reflect and discuss their own experiences to identify features of a good lesson in the first workshop. This would be followed in the second workshop by a viewing of the video interview with the year 9 students about their learning experiences in science that I had recorded the previous week. In this way I was hoping to juxtapose the teachers’ views about features of good lessons with the students’ views to see if we could identify any similarities or differences. I was hoping that as a result we could identify the conditions for learning that Greg and I had been exploring during the previous 11 months. A summary of the three sessions in the staff development program is provided below:

  I asked the teachers to think of a good lesson and to discuss this in pairs for 20 minutes to identify what they considered to be common features of the lessons. After their discussions I collated their ideas onto a large sheet of paper.
• Session II, Wed., 26 May, 1993: "Conditions for Learning"
I arranged for the teachers to watch the video of the four year 9 students commenting on aspects of learning in science and other subjects. I was hoping to juxtapose the students’ comments with the features of good lessons identified the week before by the teachers to see if we could identify any conditions for learning.

• Session III, Wed., June 2, 1993: "Pulling Together"
In response to a comment the previous week from one of the teachers who wanted me to be more explicit about what I was getting at, I handed out a sheet with a diagram of a model that summarized my views about teaching and learning (see Appendix C). I was hoping the teachers would see the connection between what we had discussed in the previous two workshops and my diagram—in other words I wanted them to accept my "big picture" on teaching/learning.

Evaluations of the staff development program
Greg and the four teachers provided me with written evaluations on the program. The four teachers wrote individual comments and one of the teachers collated these onto a summary sheet so that the teachers could remain anonymous as shown in Appendix D. In addition, the head teacher, Greg, also wrote an evaluation of the program from his perspective as shown in Appendix E. Both responses described positive and negative aspects of the program.

Overall, the teachers reported that the content of the program was nothing new as shown by the following comments (see Appendix D for points which I have numbered for cross referencing):

• Point 1: "It was old research—a lot of it had been heard before and was therefore already in use."
• Point 9: "The features and conditions of learning that were discussed were just a review of what we already knew—however it seemed that they were being presented as something new and brilliant."
The most interesting feature of the evaluations was comparing comments from the four teachers (with whom I had previously not interacted) and Greg (with whom I had worked for 11 months exploring conditions for learning in his classroom) about these common features of the program: drawing on teachers' experiences for discussion, use of student data to assist teacher reflection, and how I interpreted what the teachers said in the discussion and recorded their ideas onto chart paper. I will now juxtapose their comments on these aspects and discuss their implications for the main study.

• Drawing on teachers' experiences for reflection

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<tr>
<th>Teachers' Comments</th>
<th>Greg's Comments (Head Teacher)</th>
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<tbody>
<tr>
<td>Point 10: It was worthwhile to get us to think of the features of a good lesson that we had taught and then discuss it—it made me look at my own teaching methods and gave me some ideas from other people.</td>
<td>Probably the greatest value was obtained from causing the staff to reflect on their current teaching practices, and in particular causing them to concentrate on what they thought were characteristics of a good lesson they had taught.</td>
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Both the teachers and Greg commented that a positive aspect of the program involved them reflecting on their practice to highlight features of good lessons. This confirmed for me the value of drawing on teachers' experiences in teacher professional development.

• Use of student interview data to assist teacher reflection

<table>
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<tr>
<th>Teachers' Comments</th>
<th>Greg's Comments (Head Teacher)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 3: “The video was very good—the students said things that they normally would not say to teachers. They were not afraid to give their ‘real’ opinion and were open and honest. It was extremely valuable to hear the students' point of view and then use that to think about our teaching methods and style. (emphasis in original evaluation)</td>
<td>The use of students on video giving their perceptions of Science was invaluable in this area. A student’s perspective certainly make the staff “sit up and listen.”</td>
</tr>
</tbody>
</table>

Both the teachers and Greg identified the usefulness of student comments to stimulate teacher discussion and reflection as these were comments that they did not normally have access to. I did not play any of the audio-tapes of
student interviews to the teachers as several comments were too personal and I believed would be quite confronting to the teachers.

The most salient comments in the evaluations, however, were about my role and the way I interpreted and collated statements from the teachers in the discussions. My intention during the program was to assist teachers to identify conditions for learning by juxtaposing their ideas with the students' interview comments. It is clear from these comments that I was not successful:

- **My role in interpreting and recording teacher comments**

  **Teachers' Comments**
  
  Point 5: Garry only wrote down (onto the butcher's paper) what he wanted to hear and also altered what we had said to suit his line of thinking.
  
  Point 6: Garry didn't convey what he was trying to do very well to us—the point of the course was not really that clear.
  
  Point 7: He tried to put words into our mouths and misrepresented the meaning of what we were trying to say.

  **Greg's Comments (Head Teacher)**
  
  There was a perception, conveyed to me by several staff members, that Gary's method of presentation, while pleasant and non-threatening, was not really open to the ideas of the group. It was commented that he only wrote what he wanted to and that he had a tendency to misinterpret people's comments to suit his line of thinking. This perception was from my perspective unfortunate. What I saw was Gary trying to draw on the experiences of the group to illustrate the main characteristics of the conditions of learning.

It is clear that the teachers and Greg had different interpretations concerning the three workshops. This is not surprising considering their different level of involvement in part one of the pilot study. Greg and I had previously worked together for 11 months as he wanted to be involved in our project and experiment with his teaching. We had extensively discussed the notion of conditions for learning and he experimented with his own teaching based on these conditions. Furthermore, we had listened to and discussed the comments from the student interviews which provided positive responses to our explorations. In short, my interpretation is that our ideas resonated—he understood "where I was coming from" because we had collaborated in the
study. This is consistent with the notion of an inside/outside model discussed in chapter 2.

It was a different story for the other teachers. They had not been involved in the previous 11 months of the pilot study, they were expected to attend the three after school sessions by their department head, the timing of the program conflicted with school exams so it was rushed when held after school and the teachers were tired. They had not experimented with any of the ideas concerning conditions for learning and there was not much time for discussion or reflection. They believed that I misrepresented their ideas when I collated their statements—in hindsight, I agree. I had an agenda for them—I was trying to draw on their experiences to see if we could identify conditions for learning—a perspective which they did not share. I had never spoken to them about “conditions for learning” so even the language was new. In short, I was trying draw on the teachers’ experiences to deliver my interpretation about conditions for learning to them—I was using a training model similar to the outside-in models discussed in chapter 2 to present knowledge that they should use in their teaching.

**CRITICAL INCIDENT 3**

It was clear from the written evaluations that although Greg and the teachers believed that the use of student data was valuable, they had different opinions about the benefits of the program. On reflection, I came to these conclusions:

- There was value in teachers sharing their views about their practice in light of their students’ experiences as long as this could be done ethically. The teachers stated the student interviews were “extremely valuable” and Greg described it as “invaluable”.
- It became clear to me that there is more to professional development than delivering ideas to teachers. Greg and I had worked together over a period of 11 months experimenting with the notion of conditions for learning. In this regard he had been directly involved in the process of exploring them together with regular discussions. This was in contrast with the other teachers who had no previous experiences with these ideas.
The student interviews provided me with enough evidence to believe that a learning environment based on Cambourne's conditions for learning had some merit for high school students. It was also clear to me that opportunities for enhancing student learning depend on the learning opportunities of their teachers. I then decided to design a professional development model for teacher learning based on what I had learned from the pilot study.

IV. Construction of a Professional Development Model

As a consequence of my reflections on outcomes of the pilot study, I designed a professional development model that I intended to explore in another context to the setting used in the pilot study. The goal of the model was not to deliver prescribed strategies to teachers, but to assist them to learn about their own practice and to help them in any directions for change that they proposed. The design of the model was based on three interrelated principles to support teachers in: (1) developing an awareness of their beliefs by encouraging them to reflect on their teaching experiences, (2) considering alternative perspectives by encouraging teachers to share their ideas with colleagues in light of recorded interview comments from their own students describing influences on their positive and negative learning experiences, and (3) generating a community learning environment based on the notion of social conditions for learning in a community (Cambourne, 1972, 1988) to promote the sharing of ideas consistent with interplay between the principles of awareness and alternatives. This model is shown in Figure 9.

The principle of awareness highlights the importance of teachers reflecting on their experiences to clarify the beliefs that underpin their practice. In this respect teachers need to become aware of their assumptions and what they know about their practice as a context for further learning (Barnes, 1992; Bell, 1993; Grimmett & Erickson, 1988; Hatton, 1995). This is consistent with a constructivist perspective on learning and according to Baird (1992), reflection is the “cornerstone” of professional development. In the pilot study teachers were asked to reflect upon the question of “Why do you do what you do?” for 20 minutes at the beginning of the first workshop for the purpose of getting them to identify features of good lessons. I considered
Figure 9. Proposed Professional Development Model
this to be worthwhile, but it needed to be more sustained. In the main study I hoped that teachers would reflect on their practice for a much longer period of time to provide them with an increased awareness of their practice.

Even though it is beneficial for teachers to gain an awareness of their beliefs through personal reflection, they often interpret events according to the way they frame their practice (Hatton & Smith, 1995; van Manen, 1977). To go beyond their existing understandings, teachers need to consider alternative perspectives to broaden their views (Barnes, 1992). This is where interview comments from their own students may play a role, so that teachers can compare understandings about their practice with the opinions expressed by individuals in the same context but from a different perspective. In this way recorded interviews from students are evidence from outside the regular teacher discourse but generated from within the classroom context. Furthermore, in listening to the student interview tapes from the pilot study, I could identify comments that were consistent with conditions for learning and so decided to collate these onto audio-tapes to make them clearer for teachers to understand. Also, alternative views can come from discussion with other teachers and so I considered it worthwhile for teachers to share their ideas in light of listening to taped interview comments from their own students.

The third principle of teacher learning, community learning environment, is necessary to promote interactions so that teachers share their ideas. Such a learning environment encourages learners to be responsible for change and to experiment with their practice whilst getting feedback from other community members. Hence, as teachers experiment with their practice, they need to reflect on their efforts and share their experiences with others in a community. Such sharing is encouraged if the social context is amenable to open and honest interaction between individuals. I believe Cambourne's conditions for learning provide a guide for establishing such an environment. Although these conditions were identified in the environment of families encouraging children learning to talk, I believe that they represent a system of conditions which may assist learning in other contexts as well. My conjecture here is not that adult learning is the same as children's learning, but there are similarities in the
social conditions that promote interactions to support individual learning. What does differ, however, between an adult and a child are the contexts for learning and experiential base of the learners.

In the context of teacher professional development, I used Cambourne's conditions for learning as a guide for organizing a community learning environment. Towards this purpose, it was assumed that teachers are more likely to reflect upon their practice and share experiences if these eight social conditions are in place:

- the teachers' own practice is the context for their learning and they become immersed in gaining a better understanding of it over an extended period of time;
- teachers become engaged in the program because they can see a purpose for their involvement and care enough about their colleagues to share their experiences;
- there is an expectation for teachers to participate in the discussions to share ideas and learn about practice;
- teachers need to take responsibility to control their learning and make decisions about what they would like to explore in their own practice;
- teachers need to try out ideas by practicing with different strategies;
- teachers learn from approximating with their ideas, meaning learning from their mistakes as they experiment with their practice;
- it is helpful to have a role model within the group to demonstrate the mature practice such as being a reflective teacher within the community;
- teachers need feedback on their practice from other teachers, me, and their students to give them a better understanding of what they do.

It should be noted that it is the combined effect of these conditions that promotes a community learning environment. Also, learning involves a back and forth process of clarifying beliefs through reflection, considering alternative perspectives, trying ideas, back to reflection again in an ongoing cycle represented by the arrows on the Figure 9 cyclic pattern. Furthermore, as the context for the learning is a teacher's practice, then information generated from student tapes or group discussions can be considered in light of each teacher's "big picture" of how they understand what they do. This is what is
meant by holistic learning—there is a context for teachers to consider new information. In addition, as teachers take control of their learning, it is often non-linear with influences coming at different times and from different features of the model as represented by the spider web that connects them.

It should be noted that the proposed professional development model is not intended to be a prescriptive formula for teacher learning. From a pragmatic perspective, there is no such thing as a fail proof theory; however, a model represents a relationship between ideas that are worth exploring and which can always be improved. In particular, these are not the only conditions that influence learning, as there are always other conditions embedded in the context—political, cultural and historical—that also influence learning. The salient point, however, is that social interactions are central for the development of any community and underline the importance of Cambourne’s social conditions for learning. In short, the conjecture upon which the professional development model was founded is that interactions encouraging teachers to share their experiences are more likely to occur if conditions for learning in such a teacher community are in place. Huberman (1995) recently argued that conditions to promote teacher learning based on the notion of a community, similar to the inside/outside models, are the same conditions for children’s learning. This includes experience sharing, reflection, experimentation, occasional demonstrations, and the exchanging of ideas. He summarized this view of professional development referring to the action research cycle that is the basis of teacher research in these communities:

The kind of problem solving built into this cycle assumes that the process of learning, experimentation, and change will be moderately complex, novel, ambiguous, contradictory, and conflicting. These are, in effect, the ideal conditions for significant learning, be it for adults or children. (Huberman, 1995, p. 217) (Emphasis in original)

It should be noted that the model in Figure 9 represents my final conceptualization and was the product of an evolution of three prototypes (see Appendix F for other models).
Summary

Cambourne (1972, 1988) and Dewey (1901, 1916) identified similar conditions for learning in family communities that encourage social interactions to support individual learning. In the first part of a pilot study, these conditions for learning were explored by a secondary science teacher in an attempt to organize a classroom learning environment based on the notion of a community. The teacher and I collaborated in this investigation over a period of 11 months and I interviewed his students about their learning during this time. In the second part of a pilot study we attempted to share ideas from our investigations with other science teachers at the school in three after school workshops. Evaluations of the workshops indicated that the teachers who had not been part of the 11 month study did not appreciate the content of the workshops and could not see the point to them. As a result of these diverse evaluations, I constructed a professional development model to be explored in the main study at a different school. In the next chapter I describe the methodology I used to conduct this investigation.
CHAPTER 4

RESEARCH METHODOLOGY

Overview

This chapter describes the methodology used to explore the value of the professional development model that was presented at the end of chapter 3. First, I discuss the design to address two research questions followed by a description of the participants involved in the study. In section three I outline methods used to collect data from the teachers as well as procedures for data analysis. Section four describes how data were collected at the beginning of the study from the teachers' students and analyzed to provide an alternative perspective for how the teachers understood their practice. Finally, I discuss the ethical dilemmas concerning my intervention in teacher-student power relationships when collecting data from students for use in the professional development of their teachers.

I. Research Questions and Design of the Study

The purpose of the study was to explore the value of the professional development model and to identify issues to be considered when using the model in a secondary school setting. As a professional development model is a "design for learning" (Sparks & Loucks-Horsley, 1990, p. 235), it was appropriate to monitor the "value" of the model by its usefulness or worth for promoting teacher learning. To address this intention, I used a qualitative conception of learning which is a "change in what is understood" (Biggs & Moore, 1993, p. 21). Accordingly, teacher learning was monitored in the professional development program by ascertaining if the teachers changed their understanding of their practice, leading to the first research question:

1. How did the teachers understand their practice and in what ways did their understanding change as a result of the professional development program?
Furthermore, I was interested in identifying features of the professional development program that influenced teacher learning which leads to the second research question:

2. *What features of the professional development program influenced change in the teachers' understanding of their practice?*

To address these two research questions, a qualitative design was deemed most suitable for three reasons. First, an assumption that underpins the model that guided organization of the professional development program is that teacher learning is holistic as illustrated by the web in Figure 9 that represents the interconnections between the features. To assess both the presence and the interactive nature of these features, it was necessary to use a qualitative design that would help explicate these interactions. Second, teacher learning is a complex process and a case study for each teacher was considered to be desirable to gain an appreciation for how the program influenced each teacher’s understanding of his practice. Third, a review of the literature revealed that such a model has not been explored previously, thus it seemed worthwhile to determine the possible outcomes of a program that was guided by the model. Yin (1989) notes the suitability of case studies for this type of study; however, it is difficult to identify all causal links in such a complex intervention as anticipated in his first application:

> The most important [application of case studies] is to explain the causal links in real-life interventions that are too complex for the survey or experimental strategies. A second application is to describe the real-life context in which the intervention has occurred. . . . Finally, the case strategy may be used to explore those situations in which the intervention being evaluated has not a clear, single set of outcomes. (Yin, 1989, p. 25)

A key issue in using a case study method of inquiry is what constitutes the case. In this study the case is how each teacher understands his practice and the influence of the professional development program on this understanding. Case studies of this type involving an investigation into the response of several people to an intervention has been called a *collective case study* in which “researchers may study a number of cases jointly in order to
inquire into the phenomenon” (Stake, 1994, p. 237). It is hoped that several case studies will give a better understanding of influences from the program.

II. Participants in the Study

Role of the teachers
Due to the sensitive nature of this form of professional development, which involved interviews with teachers and students about their classroom experiences, participation for both groups was voluntary. For teachers to participate they needed to believe that their involvement would enhance their professional lives by providing them with a better understanding of their practice which is consistent with the condition of engagement. In June 1993, I first approached teachers at a high school 5 km from where I worked so that I could have regular meetings with them. I spoke to the six science teachers at a lunch time meeting explaining that the program would invite them to reflect on their practice in light of their students’ comments about their learning experiences. The head of the science department rang me a few days later to say that two of the six teachers were not comfortable having me interview their students because they were unsure what they might say. Consequently, I did not proceed with the study at that school as I wanted to explore the model for the first time with all science teachers at a school interested in participating.

I approached a second group of science teachers at a school 40 km away in a small rural town of 2,500 people. The teachers had all been at that school for 12 months but had different years of teaching experience—one year, five years, and fourteen years. I had known Geoff, the head teacher, socially and professionally for several years and he arranged for me to speak to the other two science teachers at lunch time on 24th June, 1993. Geoff was interested in this program, as he had not had been able to provide any planned professional development for his teachers in his first year as a head teacher due to other professional commitments. I explained to the group that the main features of the program were to focus on what happens in their teaching as informed by their personal reflections, discussions, and views from their students recorded on interview tapes. Furthermore, if the teachers wanted to address any issues that they selected then I would assist
them in this matter. Also, I mentioned to the teachers that I believed that secondary schools were generally not good learning environments for teachers and that we would have some funding to release the teachers for several professional development days to listen to the student tapes with follow-up meetings about their practice. Hence, it was proposed that we would have a sustained effort over a period of 12 months in an attempt to support teachers to get a better understanding of their own teaching practice which is consistent with the condition of immersion. A few days after the initial meeting, the head teacher rang me to say that they were all willing to participate. I also sought approval from the principal, the Parents and Citizens Association, and the Assistant Director General of that school region.

It should be noted that the science curriculum for years 7-10 at the time had been in place for several years and was an aims-based syllabus. This meant that there was no mandatory subject matter that had to be covered. Instead, the syllabus listed 10 minimum aims that needed to be addressed in the teaching of science. Hence, schools could design their own science programs and select any content to suit the needs of their particular situation as long as the program addressed the minimum aims in the syllabus (see Appendix G for syllabus and year 7-10 science program).

**My role as staff developer and researcher**

I had a dual role in this program—as staff developer in organizing the professional development program and as researcher to determine if and how the program influenced the teachers understanding of their practice. This involved negotiations with the various participants involved as well as providing opportunities for discussion on several professional development days and in follow-up meetings. In this regard my role was similar to that of a participant-observer (Goetz & LeCompte, 1984; McMillan & Schumacher, 1993) as I interacted with the teachers in discussions and gathered data from each.

There were several ideas generated from the teacher workshops in the pilot study that were central to my thinking for the main study. First, I realized that it was inappropriate to lecture about my ideas to the teachers and so I preferred to discuss issues with them that were contextual to their interests. Also, it was obvious to me that students in secondary schools see a
range of teaching styles across different subjects each day and compare how different teachers influence their learning. In short, students in secondary schools are very informed about teaching approaches that "work" for them, but are not often asked to give their opinion to teachers. My intention was to tap into this contextual data source about teaching and learning in the school and to collate ideas about good teaching practice across different subjects onto theme tapes. In all 16 theme tapes were assembled which will be further explained in the next section. It was hoped that this use of student data in the professional development program would assist teachers to reflect upon their teaching to give them a better understanding of their practice. Furthermore, data collected from students commenting on good practice in other subjects may inform teachers about other instructional strategies as secondary school teachers rarely share ideas across subject departments (Hargreaves, 1994; Huberman, 1993).

The first part of the program was an attempt to address the teacher learning principle of awareness by encouraging teachers to reflect upon their practice. Consequently, I invited the teachers to select a science class and to think about the question of "Why do you teach the way you do?" for a month. Furthermore, I supplied journals to the teachers and we had a meeting to discuss how they could be used to assist them with their reflections. A feature that I wanted to explore in the program was the use of students' views to provide teachers with an alternative perspective on their practice. As far as I knew, this type of program had never been tried before and I was unsure where it would lead. However, the use of student views was considered to be "extremely valuable" by all the teachers in the pilot study. Hence, I interviewed students from their nominated classes to ascertain influences on their positive and negative learning experiences and analyzed and collated the student data onto theme tapes. I also organized funding for several professional development days and let the teachers make decisions concerning which of the student tapes they wanted to listen to as well as determining when to stop the tapes for discussion. A possible consequence of the program is that discussions about their practice in light of the student tapes may encourage teachers to try ideas in their own teaching. In this way, I would encourage and support teachers to experiment with their ideas to address three other conditions for learning—responsibility,
approximation, and practice. In addition, I joined them in follow-up meetings to discuss key issues and any strategies to try in their practice consistent with the third principle of a community learning environment.

The first professional development day was held on March 8 1994, and we listened to four student tapes: interest/enjoyment, responsibility, practicals and relationships. After each tape we discussed implications for practice and followed the day with two meetings after school to address specific issues nominated by the teachers—ways to make science practicals more interesting for the students and teaching strategies to tap into students’ ideas and interests. The second professional development day was held seven weeks later on April 22 1994, and we started by discussing new strategies that the teachers had been trying in their teaching as a consequence of the first day when we listened to the student tapes. After these discussions we listened to these other tapes: best science teaching, prior knowledge/experiences, and feedback. Following this day we had two follow-up meetings after school to address specific issues raised by the teachers. In general discussions and interviews I gave my opinion in response to the context of discussion as well as occasionally provided educational literature as guided by the learning condition of feedback. Finally, a key feature for a teacher at any level is a rapport with your learners—I see no difference for a staff developer. An unsolicited letter concerning my rapport with the teachers and parents at the school was sent to my employer by the acting school principal (see Appendix H). In June 1994, I moved overseas to Canada to undertake a doctoral program and the teachers had several more meetings after school during the rest of the year. In 1995 the teachers had several after school meetings and the third professional development day was held in June 1995, followed by several meetings during the rest of the year. In short, the 16 student tapes provided the teachers with an alternative perspective on their practice that they used as the focus for three professional development days and in subsequent meetings over a period of two years.
III. Data Collection Methods (Teachers)

Data were collected using a variety of methods in order to monitor any change in how the teachers understood their practice during the two and a half year study. I directly participated during the first 12 months and used the following data collection methods: lesson observations, reflective journal, my research diary, informal conversational interviews, standardized open-ended interviews, and surveys. As I was overseas during the latter 18 months of the study, the teachers continued to send me data in the form of tape recordings of meetings, electronic mail, diagrams, and fax messages.

A timeline representing key events in the program is shown below in Figure 10.

<table>
<thead>
<tr>
<th>Negotiations with teachers, principal, parents, regional director; Conduct student interviews</th>
<th>Teachers use diary and reflect for a month on &quot;Why do you teach the way you do?&quot;</th>
<th>Unstructured teacher interview followed by general interview; to student tapes</th>
<th>First Professional development day to listen to student tapes</th>
<th>Second Professional Development day to listen to student tapes</th>
<th>Unstructured teacher interview</th>
<th>Standardized open-ended teacher interview; After school workshop; Parent Meeting</th>
<th>I left Australia</th>
<th>Professional Development day to listen to student tapes</th>
</tr>
</thead>
</table>

Figure 10. Timeline of Key Events in Professional Development Program

Further details about each data collection method are now provided:

Lesson Observations
At the beginning of the program I observed each teacher over several lessons to gain an appreciation of his teaching style and to ask him several questions about his method of instruction informally after class.

Reflective Journal
The first part of the professional development program was intended to assist each teacher to reflect and gain a better understanding of his practice. I was hoping that this would help the teachers to become more aware of the way they teach and the reasons for this. During this time the teachers agreed to keep a journal to document any thoughts about their practice. I was hoping
that the teachers would continue to use their journal throughout the program and I proposed that they may wish to use this as a basis for writing their own chapter in this thesis. Unfortunately, the teachers stopped using the journal after several months as they did not have time to write in it and were not enthusiastic about writing their own chapter.

Interviews
The teachers were interviewed individually four times over a period of 12 months. Three types of interviews were used during the study\(^1\):

(i) Informal conversational interview: Each teacher was interviewed using an informal conversational interview after they had reflected for a month on the question of "Why do you teach the way you do?" focusing on their nominated year 8 or 9 class. The purpose of the interview was to enable teachers to set the agenda to give them an opportunity to express how they understood their practice as a result of their reflections. Each teacher was interviewed again using an informal conversational approach in May 1994, to ascertain his views about his practice.

(ii) General interview guide approach: A follow-up interview was held with each teacher a week after the first conversational interview in December 1993. Before the meeting, each teacher was provided with a transcript of the previous interview and a summary of my interpretation of how they understood their practice. We commenced the interview with a discussion about my interpretations as a member check followed by a discussion about what I had identified as the key issues from the first interview. There were no set questions, however, there were issues to be explored but not in any particular order.

(iii) Standardized open-ended interview: In December 1994, each teacher was interviewed using a standardized open-ended interview with six predetermined questions. The reason for this degree of standardization is that the interview was conducted by an educational researcher who had not been involved in the study and so I set the questions for him to ask (see Appendix I).

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\(^1\) These three types of interviews are explained in greater detail by Patton (1990) in *Qualitative Evaluation and Research Methods.*
Survey
In December 1993, each teacher completed a survey similar to that used in a previous professional development program for science teachers (Bell, 1993). The purpose of the survey was to provide demographic data and to gather views about how each teacher understood his practice. Most of the questions were open-ended and provided room for teacher to expand on their comments. The teachers filled out a similar survey 12 months later in December 1994 to ascertain if there was any change in their views. It was also hoped that possible influences of the professional development program could be identified from these data (see Appendix J for both surveys).

Researcher Journal
I kept a research journal from November 1993 to the present time. In this journal I recorded my own reflections about the program.

Electronic mail
Whilst I was absent during the last 18 months of the study, the head teacher, Geoff, kept me informed of progress in the professional development program by e-mail. These are important documents as they not only provide evidence that the program continued in my absence, but also documented some important developments as a result of the program. These include the teachers devising a writing policy (in October 1994), changing their science programs, the need for more funding for a professional development day, and minutes from their meetings regarding issues such as assessment that was becoming a concern for them (see Appendix K).

Group Meetings
In my absence from the program, the teachers recorded several of their group meetings and sent me the tapes. Two meetings in the second half of 1995 were particularly important for the study. In these meetings the teachers discussed and sketched their conceptualization of the professional development model to reflect the program that they had participated in. A "draft" group model was constructed in June 1995, and the diagram and transcript from the meetings is shown in Appendix L. This model was later revised to the "final" group model in a meeting in November 1995, and the diagram and transcript of this meeting is shown in Appendix M.

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Models of Learning and Personal Statement

During the program, teachers were asked to sketch a model of student learning to represent the processes involved which is shown in each case study. In addition, towards the end of the program in November 1995, each teacher sketched and explained a model of his own teacher learning as a result of the program. My instructions for this request that I faxed to the teachers in October 1995 is shown in Appendix N together with each teacher’s personal statement that explained their diagrams. Their models of their own learning and excerpts from the transcripts are presented at the end of each case study.

IV. Data Analysis (Teachers)

To monitor learning during the study, data collected from the teachers were analyzed in two ways. First, data were analyzed to identify the attributes that the teachers used to describe their practice (McMillan & Schumacher, 1993). The most salient attribute for the teacher identified from interviews at the beginning of the study became the main descriptor for the way each teacher understood his practice. In analyzing data collected during the study, I was conscious of any change in this attribute or descriptor as a result of the professional development program.

Second, an indicator of teacher learning is a change in teacher beliefs that influence how they understand their practice. Yin (1989) stated that data collected from teachers could be analyzed according to categories identified in the literature as important for supporting how teachers understand their practice. For instance, Elbaz (1983) used five categories to analyze the practical knowledge that underpinned a teacher’s thinking: knowledge of self, knowledge of the milieu of teaching, knowledge of subject matter, knowledge of curriculum development, and knowledge of instruction. Barnes (1992) suggested that Elbaz should have included “knowledge of students and

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2 Data were analyzed with the help of NUDIST Version 3 (Non-numerical Unstructured Data Indexing Searching and Theorizing). This computer program was useful for coding and retrieving data to assist analysis. Each quotation presented in the case studies has a number that refers to the text unit (TU) in the transcript.
student learning" and identified five interrelated beliefs or preconceptions that he claims are the most significant that influence how secondary teachers understand their practice: (a) nature of his or her commitment to teaching, (b) preconceptions or beliefs about the subject matter they teach, (c) preconceptions or beliefs about student learning and how it takes place (d) preconceptions or beliefs about students, and (e) beliefs about priorities and constraints inherent in the professional and institutional context. In this study, all data from teacher interviews and group discussion were transcribed. Data were then analyzed according to the five categories of beliefs that Barnes (1992) identified. By comparing how each teacher framed his beliefs over time, I made some conjectures about the influence of the professional development program on each teacher's understanding of his practice.

If teachers' understandings of their practice changed, I was curious to find out if the teachers could identify features of the program that enhanced or constrained their learning. Consequently, I examined data collected to see if teachers identified any features of the program that influenced how they understood their practice. In addition, at the end of the program, each teacher sketched a diagram representing a model of his learning which I compared to my model in Figure 9 to match any patterns (Yin, 1994). It should be noted that I never showed the teachers the diagram of the proposed professional development model as I did not want to influence their conceptualization of the program. Finally, pseudonyms have not been used in the case studies as each teacher requested that I use his name.

V. Student Data Collection and Analysis

The other key group in this study was the teachers' students. The teachers and I decided to focus our efforts on one class for each teacher to ascertain their students' views about learning. As there were only two classes at each grade level, two of the teachers selected a year 9 class and one teacher selected a year 8 class. Letters were sent to parents/guardians by the head science teacher informing them of the project to seek their permission for their child
to participate. Also I addressed a meeting of the school Parents and Citizens about the project.\(^3\)

Since the idea to use student data evolved from the pilot study, I returned to the pilot school to conduct further interviews with five individual students and two teachers to explore types of questions that would best "tap into" their experiences. The main point I learned from these interviews was that it is best to get the interviewees to talk about concrete examples to describe their experiences. Student interviews were conducted for the main study in October 1993, in which I attempted to interview 10 students from each of the three classes. I spoke to the students in the previous week to explain the purpose of the interviews and to invite their participation. In the interviews I wanted to get a wide range of student views on their positive and negative learning experiences within science as well as anecdotes about positive learning experiences across all subjects. These were conducted in the form of a standardized open ended interview (Patton, 1990) with a set of prepared questions to guide the procedure (see Appendix O for interview schedule).

In all, 29 students (10 from two classes and 9 from another) were interviewed at the beginning of the study. The purpose of the interview was to gather student comments concerning influences on their positive and negative learning experiences by asking students about concrete experiences and then probing about "ways that help you to learn" and "ways that do not help you to learn." All interviews were transcribed and I then analyzed transcript data using Cambourne's (1988) conditions for learning as categories. A good deal of the data collected aligned with these conditions because these refer to the social interactions that help students to learn—for example what the teacher does to assist student learning. As seven of Cambourne's conditions refer to the role of the teachers and students to support learning, they provide a range of what could be described as "good practice" from the students' perspective. At the time I was conscious not to

\(^3\) This is the official organization representing the parents of students in the school. My proposal was warmly received by the parents. I also presented a follow-up report to the group 12 months later and played several of the student tapes to them.
"force" data into these eight categories and made up others when data did not fit the nominated categories. For instance, Cambourne’s conditions refer only to the social influences on learning and not individual influences such as prior knowledge/experiences or reflection which were identified during the analysis. I then collated all the student comments about a particular category across the interview tapes (positive and negative comments were interspersed) by re-recording them onto separate theme tapes. If a student comment related to more than one category (e.g. responsibility and practicals), it was recorded onto both tapes. This was like constructing a qualitative data base of comments about classroom learning across different subjects from the students’ perspective. The result was 10 hours of student interview data collated onto 16 different theme tapes that provided teachers with a range of student data on learning addressing individual influences, social influences, subject specific examples of learning tasks, and examples of good teaching in science and other subjects:

1. Individual Influences: prior knowledge/experiences, and reflection;
2. Social Influences (Conditions for learning): relationships, demonstrations, responsibility, practice, feedback, interest/enjoyment, discussion, trial and error, and expectation;
3. Subject specific tasks: writing, reading, and practicals;

The 16 tapes were used in teacher meetings as a basis for reflection and discussion over a period of 2 years. A summary of the content of the tapes is shown in Table 3 and sample anecdotes from each tape are shown in Appendix P.
Table 3. Summary of Content on Student Tapes

<table>
<thead>
<tr>
<th>Basis for Learning</th>
<th>Title of Student Tape</th>
<th>Content</th>
<th>Time (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Influences on Learning</td>
<td>Prior</td>
<td>10 student anecdotes about previous lessons, knowledge or out of school experiences.</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Knowledge/Experiences</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reflection</td>
<td>1 student anecdote about rewriting work in her own words to make her own interpretation.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Relationships with teachers</td>
<td>13 student anecdotes about teachers who care or don't care about students.</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Modeling/demonstrations</td>
<td>4 student anecdotes about teachers who show students what to do.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Expectations to achieve</td>
<td>11 student anecdotes about teachers who expect or don't expect students to achieve.</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Responsibility</td>
<td>14 student anecdotes about lessons in which students can explore with their own ideas.</td>
<td>35</td>
</tr>
<tr>
<td>Social Influences on Learning</td>
<td>Practice</td>
<td>14 student anecdotes about conducting activities more than once.</td>
<td>25</td>
</tr>
<tr>
<td>(Conditions for Learning)</td>
<td>Trial &amp; Error</td>
<td>6 student anecdotes about learning from their mistakes.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Feedback</td>
<td>9 student anecdotes about teachers giving feedback directly to students.</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Interest/Enjoyment</td>
<td>18 student anecdotes about doing work they like.</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Discussion</td>
<td>17 student anecdotes about learning from discussions with teachers and other students.</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Science Practicals</td>
<td>20 student anecdotes describing science practicals that help and don't help students to learn.</td>
<td>45</td>
</tr>
<tr>
<td>Subject Specific Tasks</td>
<td>Writing</td>
<td>25 student anecdotes about students who like writing and dislike copying work.</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>Reading</td>
<td>2 student anecdotes about learning from reading.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Best Teaching in Science</td>
<td>General collection of 25 anecdotes describing good teaching in science.</td>
<td>90</td>
</tr>
<tr>
<td>Examples of Best Teaching Practice</td>
<td>Best Teaching in other Subjects</td>
<td>General collection of 18 anecdotes describing the subject students learn best in.</td>
<td>90</td>
</tr>
</tbody>
</table>

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A second group of student interviews was conducted in June 1994. The purpose of these interviews was to follow up on why a few students were very articulate about their learning in the first group of interviews and to ascertain if students could identify any change in the practice of their teachers. The students were informed about this intention before they agreed to participate in the interviews. The teachers were provided with a copy of the tape as agreed by the students.

VI. Issues of Validity

To ensure that the teachers' understanding of their practice was being monitored (construct validity), multiple sources of evidence were used as well as conducting member checks three times during the study (Yin, 1994). At the beginning of the study, the teachers were provided with transcripts of both initial interviews along with a summary of my interpretation of data. At the end of the study, I visited the school to meet with the teachers and I asked them to read a draft of their case study and to comment on my interpretations. They provided a written response to my interpretations which are shown in Appendix Q and each of the teachers read a draft of the last chapter leading to several discussions to assist me to clarify my interpretations. To investigate if any teacher learning was related to the professional development program (internal validity), pattern matching using the teachers' models of their own learning with the proposed professional development model was conducted. In this respect the diagrams were compared to identify similarities and differences. Furthermore, each teacher's personal statement and interviews were also used to support explanation-building for any causal relationship between the professional development program and any change in each teacher's understanding of his practice.

Firestone (1993) and Yin (1994) discuss three forms of generalizability or external validity in relation to qualitative research. In this study, the documented teacher learning was related to the proposed professional development model which was then compared to Dewey's (1938) theory of learning through experience and social constructivism (Prawat, 1995) in an attempt to establish analytical generalizability of findings from the study.
VII. Ethical Considerations

In this professional development program I intervened in teacher-student power relationships to gather data from students to use for the professional development of their teachers. I did this because I believed that the student data would help teachers to acquire a better understanding about their practice by reflecting on information concerning the effect of their teaching on their students and stimulate teacher discussions. This included information about teaching that may have a positive or negative influence on their students' learning. The outcome, I hoped, would be improved learning opportunities for their students.

However, it was apparent from the pilot study that this type of professional development involves ethical dilemmas. In the pilot study I made a decision to show the teachers the video interview rather than play the student audio-tapes because in the video the students talked generally about their science lessons. Conversely, in the audio-tapes the students at times mentioned specific teachers and at that time I had not thought of collating their comments. We did not use the audio-taped interviews in the workshops as I believed that these may have been personally confronting for the teachers. In short, I was making ethical decisions about how the data could be used. When making these decisions, ethical codes of standards for scholarly inquiry can be a useful guide (AERA Standards, 1992), but they do not cover all situations. Another perspective suggests that ethical principles need to be flexible, as interactions with people are so complex and contextual that they cannot be properly treated by a set of standards. This view underpins what has been called the ethics of care (Noddings, 1988):

A relational ethic remains tightly tied to experience because all its deliberations focus on the human beings involved in the situation under consideration and their relations to each other. (p. 98)

This is very much dependent on the relationships that develop as part of any qualitative research study and is based on the anticipated benefits for the people involved in the study.
Two issues are central to any ethical perspective on research—-informed consent and confidentiality to protect participants. In the main study efforts were made to inform students about the intended use of the data by discussing the purpose of the interviews a week before they were conducted, letters were sent home to parents, and participation was voluntary. In addition, at the beginning of each interview it was made clear to the students that the purpose was to discuss their learning experiences and not whether they liked or disliked their teachers. When I categorized and collated the interview data onto the theme tapes, there were several comments that I considered to be ethically inappropriate for teachers to hear so they were not included. Efforts to maintain anonymity of the students were more difficult. There were two reasons why I collated interview data from the 29 students onto theme tapes—to present the data more clearly to the teachers so they could understand each "condition" for learning, and as an attempt to maintain confidentiality for the students. I told the students at the beginning of each interview that I would be re-recording and mixing their comments with student comments from two other classes as I believed it would be difficult for teachers to identify their voices. This was not the case. When we listened to the tapes the teachers easily identified the voices of their students and as one of the teachers stated "the incidents flash back in your mind".

The fundamental issue in this type of professional development, however, is what teachers will do after they have listened to the student views. One possibility is that teachers may respond negatively to hearing criticism from their own students resulting in the use of coercive power to get back at them. An alternative is that teachers will value comments from their students and appreciate the opportunity of having access to a different perspective on how they understand their practice. For example in the study, two of the year 9 girls expressed the opinion that they disliked doing practicals in science lessons because they did not learn anything from them and would prefer to read about the topic in a book. As these two students were identified by their teacher, he no longer forced them to do practicals and has a better understanding of their preferred learning needs.

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Another issue involved here is the professionalism of teachers. This form of professional development is long term, personal, and involves a great deal of time and energy. However, I believe that this type of professional development has the potential to bring out the best in teachers. What I am talking about here is the “moral core” (Sockett, 1993) of teachers—providing learning opportunities for students is the purpose of their job. And what this program offers is a chance to become more aware of the learning needs of their own students and what “works” for them. This may result in an improved commitment to respect and care for students and to nurture the learning environment based on “the full emergence of a relationship based on mutual recognition” (hooks, 1994, p. 13).

Finally, I believe that at the center of this very personal form of professional development is the potential for developing relationships that are the key for any community. This program started off in a personal manner. I asked the teachers to consider why they taught the way they did and we discussed this over two interviews. I interviewed their students who commented on their learning which reflected their teaching. We shared these views in our meetings. I contend that through these interactions, a trusting relationship developed among the group. This was evident to me in listening to the taped recordings of the group meetings after I left and highlighted by the teachers as a feature of the program because they had time to share their ideas about their own practice. In particular the teachers stated how valuable it was being able to discuss their disappointing teaching efforts as well as their successes. Indeed, it is this collegiality and trust that fosters the sharing of positive and negative experiences which is the life blood of a community so that we learn from each other.

Summary

In this chapter I presented the methodology that guided the study and the research design for addressing the research questions. Details about the teacher and student data collection were presented as well as procedures for analyzing data. The next three chapters present case studies constructed with data collected from the three teachers over two and a half years to ascertain if the professional development program influenced how they understood their practice and features that enhanced or constrained this process.
CHAPTER 5

THE CASE OF DAVID

Overview

This chapter addresses the two research questions for the case of David. Part one focuses on the first research question and is presented in three sections. First, I explain how David understood his practice at the beginning of the professional development program including influences that shaped his understanding. Second, I analyze his beliefs that support his understanding of his practice from data collected at different times during the study. In this analysis I use categories based on five beliefs that Barnes (1992) contends are the most significant for how secondary teachers' understand their practice. Finally, I summarize how David's understanding of his practice changed as a result of the professional development program and include a perspective on his teaching from one of his year 9 students using data from an interview conducted a year after the program commenced.

Part two of the chapter addresses the second research question concerning features of the program that David identified as influencing how he understands his practice. First, features of the program that constrained David's understanding of his practice are identified. Second, features of the program that enhanced his understanding of his practice are identified supported by a model of his own learning that David sketched and explained at the end of the program showing a relationship between these features. These features are compared to the three principles of learning that underpin the proposed professional development model shown in Figure 9.

I. David's Understanding of his Practice

David as a "structured" teacher
At the beginning of the program in 1993, David was 23 years old and completing his first year as a secondary science teacher. His professional qualifications included a Bachelor of Applied Science degree and a 12 month Graduate Diploma of Education completed after his science degree. His duties at the school focused on the teaching of general science to years 7, 8, and 9,
year 11 Science for Life and year 12 Biology. In addition, David was also the year 7 patron who provided pastoral care to students in their first year of high school. His interests that related to teaching included reading about research concerning platypuses, bushwalking, and reading about experiments in journals published by the New South Wales and Australian Science Teachers' Associations. His expectations for his involvement in the professional development program were to "gain a better understanding of the ways in which students at the school learn best; to gain a better understanding of my own beliefs about teaching; and to improve my teaching" (Survey 1, Dec. 1993, Qu. 11).

Having reflected for a month on why he teaches his year 9 science class the way he does, he described his teaching style as "fairly structured" because he wanted students to get something concrete out of every lesson:

I think a fairly structured style as I said earlier. I think I like to, as I said earlier, I hope the kids get something at least one thing concrete out of each lesson, fairly straight down the line. I don't like a lot of, for example, movement in the classroom and things like that. A kid moving around unnecessarily when doing theory or something like that, I have difficulty with that, basically things like that, fairly structured, fairly straight forward would be the word. (Int. 1, Dec. 1993, TU 27)

As a structured teacher his role was to provide all students with knowledge for them to use later in their lives. However, he "filtered" the content as he anticipated that students with different abilities would take different paths in their schooling:

Well basically I feel that my job here, my role as a teacher is to give the kids a working knowledge that they can take away with them. I like them to get something concrete every lesson that they can pick up, something new that perhaps something they didn't understand or didn't know before. I feel that if the kids don't do that then sometimes maybe I am wasting my time. At the same time I like to filter out material that's inappropriate for certain classes and certain kids. I think trying to teach 9B a fairly high level of chemistry or something like that is quite irrelevant; even to some extent some of "The Periodic Table" or things like that I feel they will never use it. It's inappropriate to their later lives because I think you could conclusively say that they
won’t use it in their lives, so I prefer to give them something that gives them more of an overall picture of perhaps science and perhaps what life is all about, rather that trying to teach them exactly what’s in the syllabus but modify it to suit them. (Int. 1, Dec. 1993, TU 13)

David gave several examples of how he organized his teaching in this structured way. For instance, when teaching the topic of “Plants” to students in a lower ability class, he would give students a “working knowledge” which included content about different types of plants such as flowering and non-flowering, different types of roots and how plants survive. In contrast, with a higher ability group who would be more likely to continue onto year 11 and 12, he would give them more in-depth knowledge, “a much bigger grounding, much greater understanding to know the differences between the plants and so on” (Int. 1, Dec. 1993, TU 97). Consequently, he would provide more “in-depth knowledge” to more able students about plant classification using technical terms such as “angiosperms” and “gymnosperms.” He gave other examples of how he planned his lessons to give students knowledge that they would need in the future. Teaching this content, however, “would vary depending on the class, characteristics, ability, and how the class works together” (Int. 1, Dec. 1993, TU 73). For instance, “working knowledge” for a topic such as “The Solar System” involved giving students knowledge about how it works and getting them to build a model of the solar system. With a higher ability class he would give them more “in-depth knowledge” about how the earth’s seasons are influenced by the angle of the planet’s rotation as it revolved around the sun. In addition to building their own model, they would also conduct their own research based on particular focus questions. In relation to planning lessons, once he decided on the knowledge that he wanted students to acquire, he would divide this into smaller blocks and organize his teaching accordingly:

I think in my own mind I see doing little units of work that fit into a bigger unit that I think overlap with other units sort of thing. So hopefully instead of doing one topic straight down the line, it sort of ties in you know what we did with the water testing and hopefully ties in with chemistry. . . . I guess that is just the way it is, maybe also planning lessons, doing blocks at a time. This lesson I will do this, the next lesson I will do that. You sort of get three or four lessons in your mind and know where you are going. (Int. 2, Dec. 1993, TU 47-56)
This structured way of teaching science, however, was not always the way David taught. For instance, he liked open ended lessons with students who could work independently and gave an example of teaching an after school science interest group called “Spectrum” in which the students worked on independent projects. Also, he gave a classroom example of being flexible with his 9B class and described how he took them to the library when teaching the topic of “Mining.” In this topic he divided the class into five groups so that they could pretend to be executives in a mining company and make decisions about how to construct and organize a mine. But he was reluctant to teach this way because some groups covered more content than others and “I think that it does not all end up tied together and it does not all fit together to form a big picture” (Int. 2, Dec. 1993, TU 40).

Influences on David as a “structured” teacher

In the first interview David provided many examples of being a structured teacher but no reasons for why he was like that. In our subsequent interview a week later I asked him if he could provide any reasons that influenced how he developed this style. He explained that his structured style was mainly based on the way he had been taught science in secondary school. He enjoyed learning science in his own high school education and in his science degree finding the work hard but “fun at the same time.” Consequently when he started teaching, he based his pedagogy on what worked for him at school providing students with knowledge in a linear order which he liked because it was consistent with his approach to life as well:

I think that a certain amount goes back to my schooling when, in particular, in science I had it very straight forward. If ever we did a practical it was aim, method, results, conclusion. It was always straight down the line and a lot of it was theory and library work and stuff like that which I like I guess, yeah. I get sick of it sometimes, but I do like it that way or I used to when I was at school. Why else? I guess well maybe everything I do in life is structured too. I sort of always think about it and by doing this I do that step, then that step, then that step and that step. I don’t sort of go into making decisions in life and sort of take a blind leap and hope for the best. That probably comes into it too, having that sort of personality. (Int. 2, Dec. 1993, TU 23)
When asked about his own school experiences, there were several science teachers who impressed him, but there were also others that wrote on the board too much which he did not like.

When asked about the influence on his structured style from his teacher training completed 12 months earlier he commented that his Dip. Ed. was "bullshit" (Int. 2, Dec. 93, TU 99) and he believed that it did not prepare him for teaching. He found education subjects were not as rigorous as subjects in his science degree as there were no "100% or 80% exams that we had to know stuff for, it was assignment based. You give the lecturers what they wanted to hear to a certain extent" (Int. 2, Dec. 1993, TU 93). I asked David if he had used any learning theory from his Dip. Ed. and he stated that he did at the beginning, but it was a "disaster" as it did not match the complexity of the setting:

It is a bit like it sounds great in theory, you have all these brilliant wonderful ideas like you have coming out of university like I had at the beginning of the year, and you sort of try and put them into practice and it is a disaster. So I think you do need to take into account the class, the characteristics, the climate of the class, the group interaction, the social skills, the base knowledge they have got; everything like that has to come into play. (Int. 2, Dec. 1993, TU 72)

He stated that he attended all his lectures but overall he felt very negative about his teacher training:

Oh, we did a lot of stuff but so what, the way we did it was irrelevant, I mean who learns in a lecture, I mean really and truly? You can go there, I mean I rarely missed a lecture, I went to lectures and I took it in and I got a few points, well I am generalizing. But in general you do your assignments and hand them in, they're worth 70%, whatever it might be, you do your exam that is worth the other 30%. You always get through whether you turned up or not you still got through. I'm being really negative, I know, but that is the way I feel. (Int. 2, Dec. 1993, TU 87)

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1 Dip. Ed. is an abbreviation for Graduate Diploma of Education. This is the 12 month university course in a Faculty of Education for certification to be a teacher. This was completed at the end of his 3 year applied science degree.
He did, however, find his experiences on practicum valuable "because I learnt five times as much on practicum as I did at university because I was actually in a classroom." On his practicum he was placed with a conventional teacher and so he modeled the structured style demonstrated. But overall his teacher education subjects did not have much influence on his views about teaching:

This is how I honestly feel. I really feel that my Dip. Ed. was a waste of time because I didn't really learn much. I got a bit of paper at the end that said I could teach, so what? The real thing that tells you whether you can teach or not is how you end up at the end of your first year. To me that is the telling tale. (Int. 2, Dec. 1993, TU 97)

Consequently, when he plans lessons "I use what I sort of know in my head and I guess a few broad concepts which you pick up along the way" (Int. 2, Dec. 1993, TU 93).

I also asked David about any influences on his practice from professional development courses that he had attended in his first year of teaching. He claimed that these were "in most cases a waste of time" because they suggested ideas that need too much change and are different to what he is used to doing:

My personal view is that a lot of inservice days are wasted on that basis because they either require too much work or they require program changes or they require too much effort and research and they are different to what you are used to doing. I think they are a waste of time to a certain extent. I know that the "Beginning Teachers" one at the beginning of the year. I didn't get anything out of that. We knew all that stuff, we had done it all. (Int. 2, Dec. 1995, TU 77)

He did, however, find it valuable talking to other teachers at inservice courses about what works for them in their teaching and looking at new resources, "the most valuable have been talking to other teachers, watching or listening to them teach and looking at and modifying new resources and information" (Survey 1, Dec. 1994, Qu. 21).

In summary, David's understanding of his practice as a "structured" teacher was mainly based on his "apprenticeship of observation" (Lortie, 1975) assuming that the structured way he learned science at school was also the
way his students would learn. This approach to teaching was also reinforced by his sponsor teacher on his practicum who taught in a conventional manner. Furthermore, this way of teaching was consistent with his personality and his organized approach to life as well. His educational coursework, however, did not contribute to his understanding of teaching and he felt negative towards his Diploma of Education course because theory presented did not match the complexity of classroom interactions and he did not "really learn much." In addition, inservice courses he attended in his first year of teaching also did not have much influence on his understanding of teaching because they suggested ideas that required too much change. In the next section I describe the beliefs that support David's practice as a structured teacher, and any influence on these as a result of the professional development program.

David's beliefs that support his understanding of his practice

Five related preconceptions or beliefs about teaching have been identified by Barnes (1992) as the most significant for how secondary teachers understand their practice: (a) nature of their commitment to teaching, (b) beliefs about subject matter, (c) beliefs about student learning, (d) beliefs about students, and (e) beliefs about priorities and constraints inherent in the context. In this section I use these as categories to analyze David's beliefs from data collected at different times during the study. By comparing how he frames his beliefs over time, I make some conjectures about change in David's understanding of his practice during the professional development program.

(a) Nature of David's commitment to teaching

David has always been committed to his teaching. In his first year he not only taught his science classes but volunteered to be a year patron which is unusual in the first year of teaching. In our second interview in December 1993, he described himself as "enthusiastic" and was disappointed by other teachers who were not prepared to do extra work to change. In May 1994, he stated that his involvement in the professional development program was providing him with more satisfaction from his teaching than he had previously experienced and he believed that his students were learning more
than before. Comments in a taped group discussion at the end of 1995 indicated that his enthusiasm about the professional development program had not waned, and he was looking for a new stimulus “to concentrate on, to work towards.” He stated that he could listen to the student tapes “forever, and ever and ever”, but they had been recorded in 1993 and he wanted some fresh feedback from his students. He posed the possibility of seeking regular feedback on his teaching directly from his students to see if they could identify change in his teaching. Data collected at different times during the study that relate to David’s commitment to teaching are shown below:

### Data regarding David's commitment to teaching

<table>
<thead>
<tr>
<th>Date</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 1993</td>
<td>I am enthusiastic, I am keen, I like trying different things, experimenting around. One thing that turns me off is teachers who have become cynical. You notice that on staff development days, there would be a couple of us who are really keen and saying “That might work quite well, we will have to modify it here and here but in general, great.” And from others you hear “Oh, we can't be bothered with that, it is more work you know”. (Int. 2, Dec. 1993, TU 76)</td>
</tr>
<tr>
<td>May 1994</td>
<td>If I'm getting more satisfaction out of what I'm doing now, and the kids are learning more, why would you go back, do you know what I mean? I think, to me, teaching is all about me feeling that I'm doing a good job. And if I feel I'm doing a good job, I feel much happier, I'm a much happier person. That's the way I want to be. If you were to go back and the kids weren't learning as well, you wouldn't get as much satisfaction so I can't see that for me personally. I mean, someone for who maybe teaching didn't affect them or their job, maybe that's a possibility, but I've been more interested in looking at where it [the professional development program] goes from here. I mean, I think I've got a lot out of it. (Int. 3, May 1994, TU 317)</td>
</tr>
<tr>
<td>June 1995</td>
<td>I think in a way we might be reaching a point that from my personal, where I am up to, where I need something, a new section or a new something to concentrate on to work towards. This seems to be going OK and this is just a matter of continuing teaching and looking at the classroom changes and that. I am not sure if we haven't done that or going back and resurveying the kids and looking at change. ... In a way I think by looking at the kids again and seeing if they can pick up change. I guess if we look at it a bit personally, in some ways I would like someone, a kid, to have a really good talk about it sitting in my class what it is like. (Group Discussion, June 1995)</td>
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</table>

In short, David did not change his commitment to teaching during the professional development program as he has always been committed to his teaching. He did, however, claim that the professional development program helped him to maintain his commitment because he was getting "more satisfaction out of what I'm doing now and the kids are learning more" from
his changed teaching approach. By June 1995, his commitment had not waned and he was seeking something new “to work towards.” In this regard he was seeking fresh feedback from his students to see if they could notice any change in his teaching because the student tapes were nearly two years old.

(b) David’s beliefs about subject matter

At the beginning of the program in December 1993, David described himself as a “structured” teacher and his role was to provide students with science knowledge for future use in their schooling to “give the kids what they really need to know” (Survey 1, December 1993, emphasis in original). He categorized science knowledge into two types, “working knowledge” for lower ability students and “in-depth knowledge” that more able students should learn as well. It was his beliefs about subject matter that dominated his teaching because he organized lessons by doing “blocks at a time, this lesson I will do this, the next lesson I will do that. You sort of get three or four lessons in your mind and know where you are going.” (Int. 2, Dec. 1993, TU 56)

Several months later in the program in May 94, he was beginning to have doubts about the content of his teaching because of the professional development program and "I'm not convinced that what we are teaching at the moment is what we should be teaching" and was contemplating “a pretty big shake-up.” He was impressed by the fact that students in his lower ability classes could design and make clever inventions and this made him question his view of what constitutes “science.” By June 1995, he clarified his view of subject matter, as shown in the excerpt from a discussion at a meeting with the other science teachers. He had come to the conclusion that the purpose of teaching science should not be just to prepare students for future classroom studies, but should be more relevant to the students' current lives outside the classroom so that they can “think through issues that they are going to face.” Data collected at different times during the study that relate to David’s beliefs about subject matter are shown on the next page:
Data regarding David’s beliefs about subject matter

**December 1993**

Science is a body of knowledge which explains—or tries to—us, our surroundings and our environment... Let’s give the kids what they really need to know to give them the knowledge and skills they really need. 
(Survey 1, December 1993, emphasis in original)

Some kids if they are going to go to university or TAFE or do further study later on or even to go to years 11 and 12, it is important that they have to know, well they don’t have to know, but for their courses later on they have to have, I think it is better for them to have a much bigger grounding, a much greater understanding. (Int. 1, Dec. 1993, TU 97)

**May 1994**

I mean, I look at it now, and it’s tied up with the program [professional development program] bit; I’m still not quite entirely sure exactly what in science teaching we’re actually supposed to be teaching. And if I look back at what I’ve gained from this program and from my own thought patterns and whatever, I’m not convinced that what we’re teaching at the moment is what we should be teaching. And I don’t quite know a better way of doing it in terms of the whole spectrum of things... I see a pretty big shake-up of how everything is. (Int. 3, May 1994, TU 321)

**November 1995**

I personally think we can do more in our programs. I think that we need to look at exactly what we are teaching and try to give the kids options and electives within subjects. I think we can do this particularly in terms of years 9 and 10. I think we can sort of refine more and actually say to kids you could do forensic science, you could do a topic on consumer science, or you could do a topic on organic chemistry, or whatever the case may be, instead of just looking at sort of topics that aren’t related to the outside world. I think we can do more in that sort of way. (Personal Statement, November 1995)

In short, David reframed his beliefs about the purpose of teaching subject matter from providing knowledge that students need for future schooling to focusing on an understanding of current socio-scientific issues outside the classroom that students are facing locally and internationally. He attributed this change to “what I’ve gained from this program and from my own thought patterns” (Int. 3, May 1994, TU 321). Interestingly, the professional development program did not focus on views about subject matter but some students on the tapes questioned the purpose of learning science stating that it needed to be more relevant to their lives.

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\[2\] TAFE is an acronym in Australia for Technical and Further Education which is for students seeking further education beyond years 11 and 12 but not at the university level.
(c) David's beliefs about student learning

At the beginning of the program, David's beliefs about learning in science centered on students "building a store of information which is built upon year after year about themselves and their surroundings" (Survey 1, Dec. 1993). He believed that this storage process occurred in "three, four or five different ways." These "ways" related to different types of activities and so he provided a range of lessons such as science practicals, theory lessons, library lessons or lessons where students discussed and answered questions. He later explained that this variety of activities would address different learning styles and so "it is important to use as wide a variety of techniques as possible in the teaching of science." Therefore, his beliefs about learning were related to his beliefs about subject matter, as he was able to structure lessons by providing "working knowledge" or "in-depth knowledge" which the students "learned" by doing a variety of activities. This was a simplistic view of learning as it reinforced David's position as the main source of knowledge and did not take into account his students' prior understandings or interests.

By May 1994, his beliefs about student learning had changed and he had "trouble describing it" because it was more complex than he had previously envisaged. Because of the student tapes he realized: that learning "is so complex" and each tape had "a different set of complexities." Ideally he wanted to incorporate ideas from the tapes into every lesson but that "I haven't quite worked out a model that works in every situation to bring it all together." In December 1994, he explained that he thought he had an idea about the way kids learn when he started teaching so "I will give them a few bits and pieces" to address different learning styles. However, because of the professional development program and "after listening to the kids and listening to the evidence on tape" he gained a better understanding of learning and this "prompted me to change." Data collected at different times during the study relating to David's beliefs about student learning are shown on the next page.
• Data relating to David's beliefs about student learning

December 1993
Learning in science to me is building a store of information which is built upon year after year about themselves and their surroundings. This learning involves many different activities; each student learns differently at different stages of their lives as they go through different stages, therefore to me it is important to use as wide a variety of techniques as possible in the teaching of science (survey 1, Dec. 1993).

Yeah, well I think that kids learn in those three, four, or five different ways. You can break it up as fine as you want to, but I think that in general some kids learn by doing practicals, some kids learn by doing theory, some kids learn by doing research, some kids learn by doing questions, some kids learn by giving them challenging questions and things that require them to think and work through things. (Int. 2, Dec. 1993, TU 68)

May 1994
Yeah, I'm having trouble describing it because it's skills, it's knowledge, it's practices, it's thought patterns, it's everything together the way that I would think about it. I've looked at the tapes, the different ways of learning; I think each of those has a different set of complexities or bits and pieces that can or need to be drawn in. It's impossible to give a simple definition of learning because it is so complex. (Int. 3, May 1994, TU 182).

Collectively, I think as I said a minute ago they [student tapes] represent ideas or goals that I would like to incorporate into the classroom in every lesson. I haven't done that yet, but ultimately there are some that stand out more than others. But, I think together, they represent a pretty good summary of how kids learn and how we learn from that point of view. I haven't quite worked out a model that works in every situation to bring it all together. (Int. 3, May 1994, TU 381)

December 1994
I thought the biggest difference in the way the kids learn. I thought I had an idea, and I thought that I was doing it actually when I first started. And I, you know, you sort of listen to what they say in the Dip. Ed. and stuff that kids have different learning styles blah, blah, blah. And I thought "All right, I will give them a few bits and pieces and whatever you know." I thought I was doing it, but after listening to the kids and listening to the evidence on tape, it was so consistent a lot of it, most of it anyway that you really couldn't refuse it and I think that that has prompted me to change. (Int. 4, Dec. 1994, TU 13)

Before I would have just said it was from reading or whatever or talking or something like that, but it's much deeper than that. I thought about how students in my classroom learned, and as you know, I know there are a lot of different learning styles and kids learn in many different ways. (Personal statement, November 1995)

In short, David changed his beliefs about student learning from several learning styles to include a consideration of the complexity of learning incorporating the "ways" presented on the student tapes. This change represented a more comprehensive view of learning than several learning styles incorporating "the different ways of learning . . . each of those has a different set of complexities" which was compelling to David because of the "evidence on tape." Also his view concerning the outcomes of learning changed from "building a store of information" to "made up of knowledge,
skills, experiences, memorizing, feelings" because of the program. In November 1995, David sketched a diagram to represent a model of student learning which is shown in Figure 11. This diagram shows learning to be more than body of knowledge and "three, four or five different ways" but rather a relationship between experiences, reflection, adaptation, manipulating, modification, and incorporates the student's attitude to learning. Also, it highlights the way that current learning influences future learning opportunities.

Figure 11: David's Conceptualization of a Model of Student Learning
(d) David’s beliefs concerning students

At the beginning of the program in December 1993, David believed that students should acquire a level of knowledge for future classroom use. In addition, he believed that students of the same ability level should learn the same predetermined amount of knowledge and skills in each topic. In this regard, more able students should get “in-depth knowledge” to provide a solid foundation for their science studies later on in school. For the less able students, they should acquire “working knowledge” about farms and forestry for when they leave school at the end of year 10 or for TAFE courses. Five months later in May 1994, he had changed this view of students in terms of the extent of knowledge that they should acquire. He also considered his role as a teacher was to “facilitate learning” which was a marked change from his role as a “structured” teacher. Instead of aiming for students to acquire a predetermined level of knowledge, he felt that students should "get something out of it that is to their ability and their standard" as it is “quite irrelevant” to push a level of knowledge that they may need in the future. Also by May 1994, he had developed another framing of his view of students. Because he valued students’ views on his teaching as a result of listening to the student tapes, he was regularly self-evaluating his teaching by “thinking of myself as a kid in that room” and imagining what students thought about his teaching to get a better understanding of his own practice. Excerpts from David’s interviews during the study relating to his beliefs about students are shown on the next page.
• Data regarding David's beliefs about students

December 1993
I think for each class, I like each class to get things out of it and I expect kids of the same level each year to have the same outcome if you like, to have the same skill and knowledge at the end of it. But the way that the lessons are carried out, yes it does vary according to the class. (Int. 1, Dec. 1993, TU 33)

May 1994
It has changed in terms of the extent that the kids come into my room, get something out of it that is to their ability and their standard, and that's as far as they're going to achieve, then I'm happy. And I think that's what my role as a teacher is to facilitate learning in many different ways and at many different levels. For example, trying to teach some kids higher level stuff is quite irrelevant, it really is pointless. It only makes them dislike school and it holds the other kids back in many ways. Yeah, so I think teaching kids at their level. I don't see that as being a dramatic change from what I was saying before. I don't know how you perceive that, but that's how I think. (Int. 3, May 1994, TU 128)

May 1994
And yet before I don't remember thinking of myself as a kid in that room and what they'll be thinking and what they'll be learning. And I think it's been valuable from that point of view to be able to do that. . . . Sometimes I actually, well, not physically, but in my mind I put myself sitting in that room and I sit myself down with the kids and do the kids' work; how would I be feeling or what would I be wanting to do or what would I be learning? And sometimes you think, "Yeah, this is good". But other times you think "Uhhh, you know, I should do something about this". . . . I think in many ways before I set out to teach in one way and that was my way, the way I was comfortable doing it and going off and doing it that way. Yeah, I think that's changed. (Int. 3, May 1994, TU 116-120)

In short, David changed his beliefs about students as a result of the professional development program. The first change related to the amount of knowledge that he thought students should acquire from a predetermined level of knowledge that David set for students of the same ability to a level that is "to their ability and their standard." Also, as a consequence of the professional development program, he realized that he used to teach the way that was suitable from his perspective on his practice, "I set out to teach in one way and that was my way, the way I was comfortable doing it." However, as a result of the listening to the student tapes he had a new framing of his beliefs about students because he began to value student opinion on his teaching and he now tries to imagine looking at his teaching on a regular basis from their perspective.
(e) David’s beliefs about priorities and constraints in the context

At the beginning of the professional development program, David’s priority in his teaching was to give students knowledge that they would need for their future education whether they progressed to university or TAFE. Consequently, he felt he needed to teach in a structured way so that he would be able to give the students either a “working knowledge” or an “in-depth knowledge” to prepare them for later educational opportunities. In May 1994, he discussed how the HSC was a constraint on his “flexible” teaching even for lower secondary classes because he had to keep in mind what students needed to know in science several years later. This was reinforced in his teacher education coursework as it focused on how to teach content, not so much about student learning. In November 1994, he still discussed how the HSC was a constraint on his “flexible” teaching. Furthermore, the type of student was another constraint, especially when he was trying to encourage students to be more independent in their learning. However, he managed this by various strategies such as setting the independent students tasks and spending more time with the less independent students. Excerpts from David’s interviews describing constraints on the teachers in the context are shown on the next page.

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3 HSC is an acronym for Higher School Certificate. This is the award presented to students at the end of year 12 when they complete their last two years of high school. There is a heavily prescriptive curriculum for all subjects related to formal statewide exams.
Data regarding priorities and constraints in the context

December 1993

Basically I like to give kids stuff that doesn’t cut off opportunities later on, opportunities to achieve, to get good jobs, to go to uni[versity] or TAFE or do further study later on or even to go to years 11 and 12, it is important that they have to know, well they don’t have to know, but for their courses later on they have to have, I think it is better to have a much bigger grounding and a much greater understanding. . . I would do a lesson to sort of suit the kids for later on in life I guess more than anything for what they want to achieve, what they want to do. I wouldn’t like to cut off a kid’s options because I hadn’t done X whatever it might be. I would hate to think that a kid hasn’t done a certain amount of work that I would be cutting him off.

(Int. 1, Dec. 1993, TU 101)

May 1994

I bet if you ask some of those kids they would see a pretty dramatic turnaround. But because that was the way that we were taught at university, we were sort of told that, “You know, the HSC was the big goal at the end that we had to sort of work towards.” And that it was our responsibility to get kids through that basically. We were never really encouraged to think about how they were learning. We were more encouraged to think about how we would teach it, and what’s the clearest way that we can do that. Yeah, so I think it’s changed dramatically since then.

(3, May 1994, TU 199)

November 1994

There’s a couple of really difficult kids in terms of any classroom environment and that makes it hard to do all the things you want to do. But I get around that by sending off other kids, a lot of kids or whatever or stay with that particular group or whatever. There’s sort of ways and means around it, you can incorporate different strategies. But that I think is one limitation of the program of teaching in that sort of style is the particular class of kids. . . And the other thing that is a strain is in the syllabus; you must cover this for the HSC, that’s a problem. I’d find it more difficult to do all the things I’d like to do with year 11 and 12 for that reason, cause I’m sort of always conscious of kids, well they need to get to this end point, and that tends to be a little bit restrictive.

(4, Dec. 1994, TU 177)

In short, a constraint on David’s teaching throughout the program was that he was conscious of the knowledge that students would need for future schooling. This was driven by the formal statewide curriculum for years 11 and 12 called the HSC. This formal curriculum constrained him being flexible with his teaching because he was always conscious that they had to get to a certain “end point”. Another difficulty in being more flexible with his teaching involved the type of students that he had, as some were less independent than others which he saw as a “limitation” of the program. He was able to manage this, however, by setting work for the independent students as a group and focusing his time on the less independent students. In the next section I summarize David’s change during the professional development program from a “structured” teacher to a “flexible” teacher.
David's change to a "flexible" teacher

Several months after we started listening to the student tapes, David changed his understanding of his practice to being "a lot more flexible" because he thinks about "how the kids are going to learn." He did not have this "mind frame" before and he now considers what students are thinking during his lessons:

The thing that has affected me most is when I'm thinking of what I'm doing, I try to think of how the kids are going to learn and how they're going to learn it best. And I don't think I ever had that mind frame before. I never thought of it in that way before. . . . The way I teach, that has changed. I think by focusing more on looking at the ways the kids learn, I think I've become, as I tried to describe earlier, a lot more flexible. Trying to do different types of things with kids that I wouldn't have thought of before. Even so much as approaching kids and so much of what I actually do in the classroom in terms of trying to be more energetic and trying to sort of show some emotion sometimes, get excited about things and that type of thing. Even so much as thinking of, if I were in this room, what would I be thinking right now about the lesson? (Int. 3, May 1994, TU 77-82)

This change in his understanding of his practice to a "flexible" teacher was in conjunction with a change in his beliefs concerning subject matter, students, and student learning. He explained that when he began teaching, he organized his instruction based on his knowledge of subject matter, which was the way he was taught at school, because he did not know "how to get his students to learn the most." Towards this purpose he divided his knowledge into "bits and pieces" and presented this content accordingly. As a result of the program, his beliefs about the purpose of teaching subject matter changed from giving students knowledge for future schooling to knowledge, skills, values and attitudes about socio-scientific issues that were more relevant to the students. Also, his beliefs about students changed from acquiring the same predetermined information to getting content that is at their level. In addition, his beliefs about student learning changed from several learning styles to many styles and "ways" of learning which have different levels of complexity. Hence, the main reason he changed from being a "structured" teacher is that he did not think that students learned that way very well and he now adapts his teaching to different classes and situations:
I think in many ways it looks good. You have nice neat labs, you have nice quiet directed lessons. I know what I'm going to be doing next lesson because it's on the program; teach about "x" and then teach about "y". But I don't really think the kids learn that way as well. I would have said it was good before, I would have said "You know that's the way I want to teach, very structured, very organized, very straightforward, no risks, no nothing." But I don't think the kids learn that way very well. I'm not saying that I've got it all together now because I certainly haven't, but I think teaching has to be an evolutionary process, I think it has to be something that is changing and is adaptable to different classes and different situations, and even different times of the day. (Int. 3, May 1994, TU 193)

This flexible approach, however, was not the way David always taught. In the group meeting in June 1995, David made the point that his teaching needed to be adapted to the type of class depending on whether the students were independent learners. He stated that when he thinks about teaching a topic, he considers how the students are going to learn it, "when I come to think of something like how I am going to teach this, this sort of thing comes up in my mind—how the kids are going to learn it and then it ticks over from that and then go through from there. Like we may start here and then go there, do this, that and the other." He has started to realize, however, that not all classes respond in the same way to his flexible teaching and that he needed to teach according to the way the class responds. For example, his year 8 class were mostly independent learners and could conduct their own investigations. However, he found that students in the top year 9/10 class, would not persist with problem solving and so he has reverted back to being more structured and occasionally used worksheets. Interestingly, Craig who had also taught the year 9/10 class had found the same thing "that the kids won't do things by themselves." Geoff commented at the time that perhaps the younger students were more independent because "the year sevens and eights have come up with a system where we have all been trying to, well the sevens and eights have sort of been trained that way. They have been brought up in a classroom climate where they are not used to anything else and so they know what is expected of them." A summary of my interpretation of the change in David's understanding of his practice from a "structured" to a "flexible" teacher is shown in Figure 12 followed by views on his practice from one of his students from an interview in June 1994.
Figure 12. Summary of My Interpretation of David's Change in his Understanding of his Practice
A students' view on David's practice

In June 1994, I interviewed one of David's students to ascertain if he could notice any change in David's teaching over the six month period since the beginning of the year when we started listening to the student tapes. David selected Shaun from year 9 to be interviewed because he was an articulate student. He described how David was using a "jigsaw" method by dividing the topic of "Evolution" into sections and giving the students choices about what they would research and present to the class:

What he has been doing a lot of this year is that we would go off in a group, two or three of us and we would research it all, find it out and we would come back to the class with sheets and we would do our own talk and explain it and that makes it a lot easier for everyone because everyone doesn't have to research all ten of them. And I find that it works because if you see your friends up there you tend to listen more and have more respect in a way because you can relate to them. Like they would put it in their words as well and you can relate back to that and there is more talking and there is work involved in it as well. You get a sheet you have to read and I think you can remember a lot of the information from it when a topic comes up. When a topic comes up you can remember "Oh yes, so and so did that" and you can replay it all through your mind. You can remember who was doing it and you can remember the conversation that was going on with it, the questions that were asked. (Student Interview, June 1994)

Later in the interview, Shaun described how David's teaching at the beginning of the year was more like "a normal way". He stated that working out of textbooks was easier but "your mind doesn't sink in with it". He explained he liked being given some choice in topics to do his own research because he could relate more to topics in which he was interested. This way of working was harder, but "it seems to stick in your mind more":

He was like sort of working out of the textbooks sort of work, and there was a few experiments at the start of the year. We did a few of those and he would come out and teach it in a normal way like we would get a textbook each or something, he would read it out and we would have to answer questions on it. You have to read a certain page or something and answer questions or he would come with sheets on something. Sometimes we would spend time up in the library doing work in the library. It wasn't so much looking up ourselves, it was we would look up small pieces of information for ourselves in that but since he started doing that it makes it a lot easier I think. When you have to work
you have to learn it more and look for it yourself, because it is pretty easy when you have to write it down or read a couple of paragraphs and answer questions on it. It is pretty easy then and it doesn't seem to stick in your mind when it is done that way. Like it was a lot easier but your mind didn't sink in with it, you sort of just wrote it down and it was in your book and you forgot about it. When it comes to tests you just, you try to read through it but you wouldn't remember it and you get, I found it harder to get marks that way but I like it better when you look it up yourself and when you get different topics you can choose yourself, you can choose something that you can relate to. If we are interested in one thing we can do that and if you are not so interested in another topic, it doesn't have to be done and you tend that when you find something that you are interested in, you look it up more and you work harder towards it to making it right. It seems that the work is a lot harder but it seems to stick in your mind more. (Student Interview, June 1994)

Shaun's interpretation of his learning in science supported David's description of himself as a "more flexible teacher" such that he was letting students pursue their interests regarding a topic and giving them more responsibility to control their own learning. In the second part of the chapter I describe the features of the program that David identified that influenced how he understands his practice.
II. Features of the Professional Development Program

In December 1994, 18 months after the program started, David was interviewed by an educational researcher who had not been involved in the program (see Appendix I for interview schedule). He asked David if the program had assisted him in understanding his practice. David replied that he began teaching based on the way he was taught at school and what he had seen on his practicum because this is all he knew, but the program had helped him to understand a range of issues related to his teaching:

Yeah, it has helped me a lot. I think before as I said to Garry before; at one stage being a fairly new teacher and having 12 months experience at the time when you started and also having a past which was very much chalk and talk and get on with it and do it. It helped me a lot to understand how kids learn, why we do things, just helped me understand the whole spectrum of different students in the classroom; it's understanding different ways of learning, having different things I enjoy doing. It just helped me understand the whole thing. . . . So the way I learnt at school was a very structured way of doing it. And the Dip. Ed. was similar; the people I had for practicum supervisors were very much straight forward, straight down the line, write it on the board, get the kids working type of teachers. So I never really had the opportunity to experience anything else. (Int. 4, Dec. 1994, TU 3-9)

Several times during the study David was asked to comment on features of the program that may have enhanced or constrained his understanding of his practice. First, I present features of the program that David identified as constraining his understanding of his practice. This is followed by features of the program that enhanced his understanding of his practice supported by a model of his own learning that he sketched and explained at the end of the study showing a relationship between these features.

Features of the program that constrained David’s understanding of his practice

During the study, David identified two features of the program that did not enhance his understanding of his practice: (a) his reflective journal that he used at the beginning of the study, and (b) lack of time for discussion and reorganizing his teaching approaches.
(a) Reflective journal

He identified that the teacher journal that I asked him to use while he reflected on the question of “Why do you teach the way that you do?” and during the program did not enhance his understanding of his practice. This was because it was a chore and did not assist his reflection:

A limitation was the journal. While I can see its benefits it didn’t work. It was seen as something we had to do at the end of a day when we had little time and other things to do—therefore it was a chore and not a time of reflection. (Survey 2, Dec. 1994, Qu. 2, emphasis in original).

(b) Lack of time for discussion and reorganizing teaching approaches

David identified that at times the program involved a lot of work especially to rethink his approaches to teaching, “At times it involves a lot of work, I found that, it involves a lot more time to sort of think through how you're going to do it” (Int. 4, Dec. 1994, TU 167). He also stated on the second survey that he needed more time for discussion and reflection.

Features of the Program that enhanced David's understanding of his practice

At several times in the study David was asked to identify features of the program that assisted him in understanding his practice. He identified five main features: (a) student tapes, (b) discussion and collegiality, (c) experimenting with ideas, (d) feedback from his students, and (e) interviews and personal reflections.

(a) Student tapes

David stated that the feature of the program which had the most "impact" was listening to the student tapes because the theme of each tape was consistently echoed by other students and was compelling to him because “in 99% of the cases you can’t argue with that, you know when it is so conclusive that they learn in heaps of different ways and there are certain things that were important to them” (Int. 3, May 1994, TU 201). In particular, David identified that some tapes informed him such as how the teacher-student relationship influenced learning whereas other tapes confirmed what he already suspected:
Relationships, being aware that the kids respond. You know if you get on really well with the kids they respond. The interest/enjoyment one was important. Actually the trial and error one was good because it reinforced what I already knew but what I wasn’t practicing. Because I felt that before, if the kid didn’t get it, if a kid made a stuff up in a prac[tical] or something, well it was one of those things and I didn’t really have time to waste and muck around. Whereas now, I’d be telling the kid, “Well, hey, that’s fine, that’s what you got in your answer, now, let’s go back and let’s see how we can fix it up,” and I think that brings the kids much more in control of their learning. And it’s much more satisfying from their point of view because they can see that making mistakes is fine. I make mistakes every day and I’ve become conscious of that, that I learn from that, and that’s how I do learn. Umm, yeah, the prior knowledge was, I think anyone who tried to refute that would go down in flames. I think I already knew that, but it brought it much to the forefront knowing that kids who had some prior exposure or actually, probably the most important was from those kids who you can always pick who come from good homes tend to always do better. But I think that reinforced why in terms of their having resources available and having parents there. (Int. 3, May 1994, TU 305)

Interestingly, he explained that in his Diploma of Education course it was emphasized that he should develop a “warm classroom environment” with students, but that did not mean much until he heard students referring to this on the relationships tape. David did, however, highlight that some teachers may not be comfortable listening to their students talk about their negative learning experiences because “If you took it on personally, I think it would be your downfall. I think that’s possibly a danger where people who are fragile from that point of view could find it intimidating, I guess.”

(b) Discussion and Collegiality

David stated that the relationship among the teachers helped him to learn by sharing their successes and failures which he described as a possible limitation for a setting that did not have this collegiality:

And through our discussions I think the three of us get on really well and I think that the relationships sort of between us, we feel safe and secure, sort of as we try different things and make mistakes and admit it, that type of thing. . . . I would be concerned about running a project in a school where it didn’t have that. I think that’s one of its limitations. (Int. 4, Dec. 1994, TU 167)
(c) Experimenting with ideas
David thought that it was very important to be able to experiment with his ideas and he felt that this was a feature of the community among his colleagues, "Being able to experiment and make mistakes is essential. This does, however, need to be done in a supportive and collegial environment" (November 1995, Appendix Q).

(d) Feedback from students
David stated that he appreciated getting feedback from the students in class when he experimented with his practice because he rarely received feedback from any other sources. Furthermore, this student feedback on his efforts to change spurred him on to try other ideas:

Seeing the kids learning can be a satisfaction. Your satisfaction drives you on—"I've done that well, now OK I am going to do that, I want to do better." You've got to have that recognition, you don't get it from anywhere else really except from the classroom, you walk around and stuff or "that went really well." You've have got to get that feedback or recognition from the kids. Very rarely does someone else tell you, that is pretty rare. If you can recognize the change in the kids or the kids picked that up or I feel that something worked really well, that's what you need. (June 1995, Appendix L)

(e) Interviews and personal reflections
David's interviews and personal reflections assisted him to learn. David believed that personal reflection was possibly the most important feature in changing teaching and a vehicle for learning that students should use as well:

The interviews with Garry helped to crystallize my thoughts and views on teaching. In some cases this wasn't during the interview but at night or when I was mowing the lawn etc. Sometimes, something I said would come up and I would reflect on it. I now see reflection as one, if not the most important things in changing one's teaching. The ability to be self-critical and analyze oneself in relation to teaching is an important tool and one in which I believe we should be encouraging students to use also. (November 1995, Appendix Q)
David's model of his own learning in the program

In November 1995, 29 months after the professional development program commenced, I faxed a request to David asking him to consider some examples of change in his practice as a result of the program, and if possible, to sketch a model that represented a relationship between the features of the program that influenced his learning. Furthermore, I asked him to describe his model by audio-recording an explanation and posting it with the diagram to me in Canada. The purpose of this request was to ascertain if he could conceptualize a model of his own learning as a result of the program, and to identify if there was anything in common between the features of his model of his own learning and the three principles of teacher learning, *awareness, alternatives,* and a *community learning environment* that underpinned the proposed professional development model shown in Figure 9. The full transcript of his personal statement in which he explained his model and discussed an example of his changed practice is shown in Appendix N. In the transcript I have placed headings in bold that correspond to particular features of his model but have not altered the sequence of statements. On the next page I provide excerpts from David's transcript that describe his model of his own learning followed by his sketch of the model on the subsequent page. The first quotation corresponds to the top part of the model and describes how the learning process started. The second quotation corresponds to the center and lower parts of the model that describe what sustained the learning process.
• Top half of the model: Features that started the process

The student tapes and his own reflections started David thinking:

I think there are a number of factors that have contributed to it [his own professional development]. First of all, as I listen to the tapes on how students learned, I think that really started me thinking and started me sort of summarizing and reflecting in my own mind about a number of different things. It started me thinking why do I teach the way that I do? . . . It prompted me to think about how I learn? . . . but another thing that it's taught me to think about is what it actually means to teach science? What is science and what should I be teaching?

This is similar to the interplay between the principles of awareness (reflection) and alternatives (student tapes) shown at the center of Figure 9.

• Center and lower half of the model: Features that sustained the process

The central feature of the program for David was the discussions that provided ideas and support as he experienced a continual process of trying, reflecting, modifying, and evaluating ideas in his teaching practice:

I see the central part of the program as being the discussion and the support of colleagues, of Craig and Geoff in particular. I feel that without their sort of enthusiasm, I don't think it [professional development program] would have been quite as effective. Not only their enthusiasm, but just knowing that there's someone else having the same sort of difficulties that I was having in terms of changing what I was doing . . . knowing that we as a sort of a faculty have a type of a goal. . . . And that I think it comes from sort of the collegiality between us if that's the word, I think it is. So from the sort of the discussions and also you can bounce ideas off each other. . . . But from the colleagues, discussion and the sort of support and mateship sort of thing comes the personal side of it. There is a personal side and it's sort of the reflection on, if it's not every lesson, then certainly every few lessons or even every topic, sort of an evaluation . . . And if you can modify it, yes, try it and see what happens and go through the same sort of process of trying it, reflecting on it, evaluating it, I guess reflection is another word for evaluation.

This is similar to the principle of community learning environment shown in Figure 9 encouraging collegiality and experimentation with ideas for teaching.
Figure 13. David’s Conceptualization of a Model of his own Learning
Furthermore, David’s learning, which was instigated by his own reflections in light of the student tapes and linked to discussions with colleagues followed by “the same sort of process” of reflection, trying ideas, and reflection again, was related to a wider cycle of change for the group of teachers:

As I was saying a while ago, getting back to the colleagues, changing that—the way the programs are structured is a staff thing, it’s a faculty thing. I think without the faculty support, it will be much more difficult to do that. The same thing applies to assessment. I think it’s really important that as a faculty we change that, not just an individual teacher. Basically, the support, the ideas, the collegiality as a whole thing, I think it would be really difficult on your own to do that. So I think that’s sort of the way that it’s changed my teaching.

In summary, there are similarities between David’s model of learning and the proposed professional development model shown in Figure 9. First, the features that David identified as assisting his understanding of his practice are consistent with principles of the model. For example, his reflection on the student tapes is similar to the principles of awareness in light of alternative perspectives as shown at the center of the model. Also, he experimented with the ideas generated from group discussions which is consistent with the conditions of responsibility, practice, and approximation in a community learning environment. Second, the features of the program that David identified did not act in isolation. For example, he argued that his learning involved returning to “the same sort of process” of trying ideas, reflection and evaluation which was supported by the “collegial environment.” Hence his learning was not attributed to one feature, but several interconnecting features which is consistent with how the principles of the model are interrelated as shown by the spider web in Figure 9. There are, however, differences between David’s model of his own learning and Figure 9. For instance, David did not identify all the conditions for learning, although experimentation and feedback from students were important features for him, and the features are not in the same configuration as the principles in Figure 9. Also, David did not show a return link from changing his practice to reflection on more of the student tapes which was a feature of the proposed professional development model. At the end of the study, David read a draft of this chapter and wrote a response to my interpretations which is shown in Appendix Q.
CHAPTER 6

THE CASE OF CRAIG

Overview

This chapter addresses the two research questions for the case of Craig. Part one focuses on the first research question and is presented in three sections. First, I explain how Craig understood his practice at the beginning of the professional development program including influences that shaped his understanding. Second, I analyze his beliefs that support his understanding of his practice from data collected at different times during the study. In this analysis I use categories based on five beliefs that Barnes (1992) contends are the most significant for how secondary teachers understand their practice. Finally, I summarize how Craig's understanding of his practice changed as a result of the professional development program and include a perspective on his teaching from one of his year 9 students using data from an interview conducted a year after the program commenced.

Part two of the chapter addresses the second research question concerning features of the program that Craig identified as influencing how he understands his practice. First, features of the program are identified that constrained Craig's understanding of his practice. Second, features of the program that enhanced his understanding of his practice are identified supported by a model of his own learning that Craig sketched and explained at the end of the program showing a relationship between these features. These features are compared to the three principles of teacher learning that underpin the proposed professional development model shown in Figure 9.

I. Craig's Understanding of his Practice

Craig as a “fun” teacher

At the beginning of the program in 1993, Craig had been teaching science for 5 years and this was his second high school. His professional qualifications included a Bachelor of Science degree (major in Chemistry and Geology) and a Graduate Diploma of Education. He taught general science to classes in years 7, 9, and 10 as well as Year 11 Chemistry and 4-unit science to year 12. In
addition to teaching his science classes, Craig was year patron to provide pastoral care for year 8 students. His interests outside of school included reading about geology, collecting rocks, and watching the television program Beyond 2000 (this program focuses on the presentation of new technologies). His expectations for his involvement in the professional development program were to get "something useful, to get more out of teacher-teacher interchange rather than academics coming in and giving a professional development seminar" (Survey 1, Dec. 1993, Qu. 11).

Having reflected on his teaching of a year 9 class for over a month, he described himself as a "fun" teacher whose role was to "give the students a good understanding about why/how things are or happen in our environment. Also to give them good skill levels in useful skills" (Survey 1, Dec. 1993, Qu. 15). He believed that the best way for students to learn was to encourage them to have fun as his five years of teaching have taught him that "kids absorb less information than I originally thought" (Survey 1, Dec. 1993, Qu. 15) and "most of them will forget 90% of what you tell them anyway when they leave school, most of them probably forget 90% of what you tell them when they leave the classroom" (Int. 1, Dec. 1993, TU 18). Craig believed that it was important for students to have fun in class because if they enjoy something it will "stick in their mind":

I try to be fairly casual, get on well with the kids, let the kids tell a joke. If they say something funny in class, there is no point jumping up and down about it, you might as well have a laugh along with them. There's the odd occasion where kids sometimes take it a little bit too far the other way, they tend to take advantage of it, not all of them, but there are kids in every class who will take advantage of it. It makes it a little difficult because then I have to jump down their throats a bit and they sit back and wonder what I'll do. It's not the usual thing I tend to try to do. I think fun I suppose, exciting and fun, fun probably more than anything. If they are going to come through the door and not have some kind of enjoyment, it doesn't matter how much you drill them on something it doesn't matter, it's not going to stick and it will go in one ear and out the other anyway. So I tend to think unless they enjoy it, usually with most kids, if they enjoy something it will stick in their mind if they try to make it stick or not. (Int. 1, Dec. 1993, TU 8)
He believed that the best way students learned in science by having fun was by doing science practicals, "three quarters of what I do is prac[ticals] and 25% is theory. It is a bit hard to work out a percentage it depends on a topic. If I have six or so lessons in a week, probably four we would do some kind of prac[ticals]" (Int. 2, Dec. 1993, TU 15). Consequently, he mainly taught science by organizing content followed by practicals as "most of the exciting stuff is prac[ticals] and if you don’t give them the content, they can’t do the prac[ticals] most of the time anyway" (Int. 1, Dec. 1993, TU 8). Hence selecting practicals was an important component of his teaching:

Basically I just sit down, write down everything that comes to mind I’ve done in the past in the topic and then I think about, one of the things I think about is prac[ticals]. And I think about what I can do on the topic and think about the prac[ticals] that relate to them depending on what we’ve got. A couple of the experiments I remembered from what I did at school, some were from university but most of them I suppose I, some of them I got from Clemmy [another teacher] when I first started teaching... But basically I bought, when I first started teaching, I bought some books specifically there is one set with all chemical reactions. I always look for books that have lots of prac[ticals].
(Int. 1, Dec. 1993, TU 75-77)

Craig gave several examples of how he organizes his teaching based on the practicals that he knows. For instance, when teaching the topic of "Magnetism", he gets students to follow his directions through a sequence of practical activities designed to demonstrate particular concepts in a linear order:

First lesson I usually do is where you find it? What do you use it for? Then I usually ask them what kind of things a magnet is made of. Then you tell them it is made of nickel, cobalt things like that. And then you can, I usually give them a pair of bar magnets and tell them to play with them on the desk for a while and they tell me what they do. Some of them actually haven’t had two magnets together, they have had one magnet that sticks on the fridge but never had two magnets. So they put the magnets together and the fact that in one way they’ll stick together and another way they’ll push apart is fascinating to them. And then you’ll say “Okay, why do they stick together sometimes and why do they repel?”. Like they don’t understand that because they usually stick together or push away. They never use words like “attract” and “repel” and that. Then probably put things around them and then say “OK let’s possibly talk about but they are
still being affected tell me why? Most of them cannot come up with an answer. The earth has a magnetic field and it doesn’t matter where you stand you are affected by it so it must have something to do with it. Then you get some iron filings and do shapes and stuff and the effects around it and stuff. You do different kinds of magnets so that the field depends on the shape and then we talk about north and south. Then you do electromagnets and then I do a bit of how to use it like show them how they can erase a tape. (Int. 1, Dec. 1993, TU 82)

One aspect which limited students doing practicals, however, was the availability of equipment so if there is not enough for the students he demonstrated an experiment for all the class at one time.

Influences on Craig as a “fun” teacher

Craig provided two reasons, which were both related to his own schooling, that led him to believe that it was so important for students to learn by having fun when doing practicals. The first reason related to the way he was taught science in his own high school education. He really enjoyed his own secondary schooling and he learnt the most from his favorite science teacher, Mr. Schultz, who told jokes in class and made science fun by doing practicals. Also, he did his practicum at the school where he was educated and found out more about the way Mr. Schultz taught. Similarly, Craig has built up a repertoire of amusing stories that he tells in class and when he thinks about how to teach something, he thinks of how Mr. Schultz would do it:

One of the first things is the fellow who taught me science in junior high school in years 9 and 10, Mr. Schultz, he was an American chap. When I went back to my old school and prac[ticum] taught, the headteacher went through his whole staff and basically explained to me why they all taught the way they did and he described Peter Schultz as a showman. He liked doing practical things, he was very expressive and animated, he had a personality like that too. He had a really good sense of humor, some of the jokes were just like that . . . That sort of stuck in my mind; I really enjoyed that, the fun side of things. So most of the time when I think about doing things, I try to think of the ways he did it. I try to think of somehow making it fun, but it is very hard to make some things fun. There are some topics I don’t like to teach because they bore me; that is the reason why I didn’t do them at university anyway. (Int. 1, Dec. 1993, TU 6)
The second reason why Craig was a “fun” teacher is related to his positive attitude to his own schooling and how he expected his students to like school as he did. He believed that most students like science more than English, maths and geography because it is more “fun”:

I can't stand knowing that kids come to school and all they think about school is that they can't wait to get out because I really liked school. I always enjoyed going to school, even today when I go back home I drive past my school. I can't stand the fact that they are bored and I don't like the fact that kids come to school and don't like school because I always liked school. One of the reasons I became a teacher was because I liked school. I enjoyed maths and science and when I got down to thinking about it, if I liked this then someone else will too you know cause I always liked school. I find it difficult to understand why some kids dislike school because I never saw it that way. I think when you think one way it's difficult to think or understand why some people think or look at it differently with a totally different idea. . . . But I just find it difficult to understand why some kids don't like school and it annoys me that some kids, they just give up. (Int. 1, Dec. 1993, TU 16)

When asked about the influence of his teacher training (Dip. Ed.1) on how he understood his practice he stated that the subjects were mostly “a waste of time.” He said that subjects were mainly about educational theory and designing lesson plans which were suppose to work in classrooms:

They tell you as long as you go in with a really well prepared sort of lesson and throw it at them it will work like clockwork. And not knowing any better you sort of accept it, and then you go out on practicum and you hear some of the teachers tell you that what the lecturers say is not necessarily the whole truth. Things like that, I think they are really, sometimes I think that people who do the Dip. Ed. have been out of the system too long and have been doing too much bloody theory and it is all up there and not practical enough. (Int. 2, Dec. 1993, TU 27)

When I asked him about learning theories presented in his Dip. Ed., he explained that he could not remember any. In support, he gave an example of a tutorial that he ran on “memory”, but he could not remember what it

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1 David, Craig, and Geoff attended different universities in Australia, although each university had a similar course structure involving a three year science degree followed by a 12 month Graduate Diploma of Education.
was about. He stated that his beliefs about students learning by having fun when doing science practicals were not derived from his teacher training, but from his own common sense based on his high school experiences and what he saw other teachers doing on his practicum. He described his teacher training:

It was just a waste of time. We all went, not that we really wanted to. When you look at things that we did in it like sociology and psychology, alright I suppose it is important to do that. But when you look at the things in it, I have not used one scrap of it and I can't remember any of it. . . . I had a sort of a belief that was very similar to now. Because when I started teaching, my methods were not necessarily that different from now. A bit different but there are some things that I don't believe now. I don't assume that kids will take in so much as I used to but the practical things, that hasn't changed much. But that didn't come out of doing the Dip.Ed., that came out of me thinking common sense and what happened to me when I was at school and what I had seen on my prac[ticum]. We didn't sit down, we had tut[orial]s and stuff. I remember doing an assignment on speech and remembering different ways, three ways of how you remember things, I forget now what they were [both laugh], but I had to give a tutorial on that, there was nothing actually on learning theories, on how you actually learn. If there was, there wasn't much because I can't remember doing it. (Int. 2, Dec. 1993, TU 38)

He believed that the most valuable part of his Dip. Ed. was his practicum and his science methods class in which he would go out to a secondary school once a week and a classroom teacher would show them resources, explain the syllabus, and show them how to use equipment for experiments. On his survey at the beginning of the program, he was also asked about the influence of inservice courses on his understanding of his practice in his five years of teaching. He wrote:

Most teacher development involves people coming in and telling you stuff that most teachers see as irrelevant or impractical. I feel people more closely associated with classroom work are more credible than many academics or seminar givers; not all as some make more sense. Teacher to teacher stuff is more applicable and practical. (Survey 1, Dec. 1993, Qu. 21)
In summary, Craig’s understanding of his practice as a “fun” teacher was based mainly on his “apprenticeship of observation” (Lortie, 1975) from experiences in his own schooling assuming that his students would learn science the same “fun” as he did way by doing experiments. However, his understanding of how much content students learn had been modified by his teaching experiences because he realized that “kids absorb less information than I originally thought” (Survey 1, Dec. 1993, Qu. 15). He believed that his professional coursework in his Dip. Ed. was a “waste of time” and inservice courses that he had attended in five years as a science teacher also did not strongly influence his beliefs about teaching. He claimed that his instruction had not changed much from when he began teaching secondary science five years previously.

Craig’s beliefs that support his understanding of his practice

Five related preconceptions or beliefs about teaching have been identified by Barnes (1992) as the most significant for how secondary teachers understand their practice: (a) nature of their commitment to teaching, (b) beliefs about subject matter, (c) beliefs about student learning, (d) beliefs about students, and (e) beliefs about priorities and constraints inherent in the context. In this section I use these as categories to analyze Craig’s beliefs from data collected at different times during the study. By comparing how he frames his beliefs over time, I make some conjectures about change in Craig’s understanding of his practice during the professional development program.

(a) Nature of Craig’s commitment to teaching

Craig has always been committed to his teaching. This is shown by his willingness to volunteer to be a year patron in his first year at the school because he wanted to know the students better. He was willing to participate in the professional development program and his comments in December 1994 show that he was able to accept criticism from his own students about his teaching and to change his approach accordingly. In November 1995, Craig described the professional development program as “a continually evolving process” as he needed to “reassess and re-evaluate your successes and failures” on a regular basis. Data collected at different times during the study regarding Craig’s commitment to teaching are shown on the next page.
In short, Craig has always been committed to his teaching. This included taking on extra responsibilities at school as a year patron to get to know the students better which he believed helped him in his teaching. The professional development program did not change his commitment to teaching, but provided him with an alternative perspective on his practice that he valued in the form of student interview data. In contrast to his first five years as a teacher in which he did not change much, he now believed that he had to "continually reassess and re-evaluate your successes and failures" because of his involvement in the professional development program. In this regard he was prepared to respond to criticism from his own students and change his teaching because "no group is the same".
(b) Craig's beliefs about subject matter

At the beginning of the professional development program, Craig believed that science was a subject that explained how the world works and consequently his role as a teacher was "to give the students a good understanding about why/how things are or happen in our environment" (Survey 1, Dec. 1993, Qu. 16). During Craig's previous five years of teaching, however, he came to realize that students do not "absorb" as much content as he originally thought and "most of them probably forget 90% of what you tell them when they leave the classroom" (Int. 1, Dec. 1993, TU 18). Hence, at the beginning of the professional development program his teaching emphasized students learning skills leading to an understanding of why something happens rather than teaching isolated facts. This was related to the science curriculum at the time (see Appendix G) that emphasized students learning scientific skills of inquiry (aims 6-10) as well as factual knowledge (aim 3).

Twelve months later in December 1994, his belief that it was important to teach skills that help students to solve problems had not changed. In November 1995, his beliefs about the purpose of teaching subject matter had been reinforced by "going through this process" [professional development program], however, he also believed that when students conduct their own research, "there is some background information that they might need to know no matter what they're trying" (Appendix N, November 1995). Data collected at different times relating to Craig's beliefs about subject matter are shown on the next page.
Data regarding Craig’s beliefs about subject matter

December 1993
I suppose you can put it down in the sense that science is basically the subject that explains how things that surround people, how they work. Most of junior science is common sense especially if you set it up. I think that you could get someone off the street and give them a text book and you could teach them year 7 and 8 science. But theoretically-wise, it is probably the content that is simple so that most people can pick it up. Basically if you look at the things to do we basically explain or show and tell or do to explain what is happening around them. Some of the things like electricity, astronomy, other things that are not so obvious like wind and motion.
(Int. 2, Dec. 1993, TU 46)

December 1994
I think science is not the learning of thousands and thousands of facts, it’s the learning of skills that helps you solve problems and therefore can be used to explain why scientific things happen. Like I’d rather have the kids have some concept of why something happens, like why the earth goes around the sun, rather than, or why a planet goes around the sun rather than to be able to go outside and be able to recite the nine planets in the right order . . . .all the years I’ve left school. I have been teaching for six years, I went to university for four, the only time I use any scientific stuff, really factual stuff is here or at a trivia night.
(Int. 4, Dec. 1994, TU 95)

November 1995
I think thinking about what we’ve been doing or have done, I’ve sort of changed, not necessarily changed my ideas about what kids should be learning and stuff like that, but I’ve pushed away from one end of the spectrum towards the other and boy, I mean I’ve always been keen on skills and stuff rather than big on content, but going through this process [professional development program] I believe that even more strongly. I am not really keen on highly content type programs at all and would rather see the kids develop lots and lots of skills.
(Personal statement describing professional development program, November, 1995)

In short, Craig’s belief at the beginning of the study that it was more important for students to learn problem solving skills than isolated facts did not change as a result of the professional development program. His belief was justified by listening to the student tapes in the professional development program and he “believes that even more strongly”. Hence, the professional development program did not cause Craig to change his belief about the purpose of teaching subject matter, but reinforced his existing beliefs concerning the importance of students developing skills of inquiry through his teaching such that, “my beliefs about science have not changed during the course, but my ideas on how to teach it have. (Survey 2, Dec. 1994, Qu. 5)
(c) Craig’s beliefs about student learning

At the beginning of the professional development program, Craig’s belief about learning centered on his understanding that students learn by having fun, “learning will vary from student to student, but irrespective of this, students I believe need to be enjoying themselves to learn effectively and constantly” (Survey 1, Dec. 1993, Qu. 21). In this regard, he believed that students have fun in science when they conduct practicals because this is the way he learned at school. By May 1994, he realized from listening to the student tapes that his view of organizing practicals differed from the views of his students and this has stimulated him to change his practice:

Well I think since we started I think I have changed, it’s made me more aware, well made me think about what I do. It became clear from the tapes and stuff, like I always wanted to make the stuff fun for the kids, but it became clear that what was my idea of what was fun and their idea of what was fun were slightly different. They’re sort of the same along the same lines but the way I did it possibly wasn't right. (Int. 3, May 1994, TU 3)

Accordingly, he changed the way he organized experiments from short prescriptive practicals to longer open ended practicals to allow students more flexibility to investigate their ideas when set a task. This change often involved him setting students a problem to investigate and giving them responsibility to devise their own procedures which were negotiated with him. In this regard he encouraged them to explore their ideas rather than following his prescriptive directions in practicals. He also changed his preferences for the way students recorded their practicals results from a conventional “problem, method, results, conclusion format” to a more informal style of report writing. In December 1994, he explained how his teaching encouraged more problem solving in groups and that he was getting students to write about their own investigations in a way “that they understand more.” Data regarding Craig’s beliefs about student learning from three different interviews over a period 12 months are shown on the next page.
Data regarding Craig's beliefs about student learning

December 1993
I think most people will remember things that they enjoy doing irrespective of what the topic it is. You can sit them down and bore them shitless for 40 minutes every day of the week, but after about two or three weeks of that in the year they have had it. They say “It is such a boring class” and as they go through the year the less and less they do, and the less and less they enjoy it, the less and less you get into them. But what I am saying is making things enjoyable for different kids is different. It is not necessarily how they learn but as long as they enjoy what they are doing, I think they will absorb most of it... Now if you do that enough eventually all of them, or I assume all of them will come across stuff that they like doing and they will get hold of something.
(Int. 2, Dec. 1993, TU 17)

May 1994
They [student tapes] impressed that, not totally open ended stuff, well more open ended stuff was probably something that they liked and I never used a lot of open ended things. I always did a fair few prac[ticals], a lot of structured go-away little short stuff. Cause in the past I found if you give them really long prac[ticals] they tend to get bored, they get a bit convoluted and they can't see where they're going so I basically did a lot of little short prac[ticals], like a little bit here and a little bit there, kept it very concise and did it really sort of bit by bit. But from what the kids said, a lot of the kids said that that is not the best way to do things. So I think I've tried to strike a happy medium between doing really short ones and really long ones.
(Int. 3, May 1994, TU 3)

December 1994
With this approach that we're taking with this problem solving, they've got to do a prac[tical] and write it up, like they've got to solve a problem themselves, but they all must come back with a report. So the group goes about solving the problems... And they can't start the prac[tical] until they tell me what their idea is. I don't tell them whether it's right or wrong, I just say “Right that sounds okay, it doesn't sound like you'll blow the school up or something” which was a problem with the fuel topic. You go away and try it, and if it doesn't work, it doesn't matter. The main idea is to come with a solution for the problem and they go away and try it and if they prove it, then they write down their results in a fashion that they can understand. So the other thing I've done is I've gone away from that sort of aim, method, result, conclusion to a form that they can understand.
(Int. 4, Dec. 1994, TU 26)

In short, Craig reframed his beliefs about learning from one of students having fun in practicals that he directed to one of more open ended problem solving to be conducted in groups. He attributed this change to listening to the student tapes as they challenged his belief that his students learn as he did at school. Towards the end of the study in November 1995, I asked Craig if he could conceptualize a model of student learning and sketch it for me. In his personal statement he commented, “I found it a tad difficult because I don't know whether you can sort of quantify how students learn in the one sort of sketch or theory because of the vast numbers of different students and the
different ways they do things.” Nevertheless, he attempted the task and the result is shown in Figure 14. The model emphasizes students learning through a problem solving approach in consultation with the teacher. He was, however, experiencing a dilemma with this type of learning regarding the time involved in allowing students to experiment with their ideas, as different groups took different amounts of time (numbers in quotation refer to numbers on diagram):

This is how I believe it works. My dilemma is how long should students get to revolve around 4-5B-6B-4? Some could do it in one go, others may be there for days or weeks. Maybe we could set a number of things to be achieved in X time as a minimum. The faster ones will do that and go on, the slower ones could just achieve the expected number. Have them very disjointed in where each person is up to. Doing this somewhat now but need to improve it. (Attached note with model, November 1995)

A feature of the model is shown in steps 2-6 in which he discusses the goal of a task with students, encourages them to explore their ideas by trial and error as they consult with each other or staff, and then they inform others of their efforts. This model represents a more comprehensive understanding of student learning than having “fun” by following his directions in brief practicals that Craig believed at the beginning of the study.
Figure 14: Craig's Conceptualization of a Model of Student Learning
(d) Craig's beliefs about students

At the beginning of the study, Craig believed that students should follow his instructions and "study what they have to do properly" to complete work in class. He described most students as interested when they will sit down and try to do their work, but there are others that are disinterested and do not try in class. By May 1994, he had changed his belief about the role of students in practical classes. The student tapes had supported his beliefs that students liked doing practicals, but they preferred more open ended investigations rather than following a prescriptive format determined by the teacher. In allowing students to devise procedures to investigate a problem that he posed, Craig now believed that it was important that students "own what they were doing. . . . so that they are doing it in their way but with some direction." In December 1994, he was still encouraging students to investigate their own ideas and was reinforcing students that it was not a concern if they made mistakes as long as they deduced "a feasible solution". Data regarding Craig's beliefs about students collected from three interviews over a period of 12 months are shown on the next page.
• Data regarding Craig’s beliefs about students

**December 1993**
You can get them to do practical things. They need to actually sit down and do it properly and study what they have to do properly and have a real go at doing it. Most good kids are either interested and they will sit down and watch it or they like things in general and if it is a challenge or something they will sit down and try and eventually they will get it out and they will learn how to do it. I find that kids who don’t do real well are kids who can’t be bothered or are totally disinterested and won’t even try to do it. The only way I think you can learn skills about things is by doing it. Some kids are naturally born with skills. Someone who would think doing some kind of mathematics skills. Some kids are born who can do it. (Int. 2, Dec. 1993, TU 57)

**May 1994**
The majority of kids, not all, but the majority of kids said they like doing things hands-on, so that’s all this practical stuff. They like the fact that they have some trial and error, if they muck it up they can start again. But on the other hand with those problem solving type things, they like a little bit of direction and a little bit of prior knowledge always helps. They like to be sort of, they like to do things by themselves but they like to know where they’re going. They like to know what the end point sort of it is going to be without getting the answer. And they want to know what way they’re going to go, but they want to sort of hop along the line by themselves. And in the fact that they like that, means they can own what they’re doing and if they make a blue they have got to fix it up. So they are doing it in their way but with some direction. (Int. 3, May 1994, TU 61)

**December 1994**
I’ve been trying to reinforce in the last six months, it doesn’t matter if you get it wrong because they know for a fact that when I’ve given them instructions to do practicals, some practicals work and some don’t work. You can go along with the instructions, I can give it out and the practicals works fine, get the kids to do it, and doesn’t work. And they know that for a fact cause that’s happened before. So I say “Here you go, you come up with an idea”, tell them it should work if it is basically correct. But it just doesn’t work, well now you’ve got to think of a reason why it doesn’t. Rather than saying just do the work and leaving it, try and come up with some reasons why. It reinforces the fact that if they come up with a good idea and it doesn’t work, it doesn’t matter as long as they’ve tried, as long as they come up with a feasible solution. (Int. 4, Dec. 1994, TU 76)

In short, Craig changed his beliefs about the role of students in practicals from passively following his instructions to recognizing that they should have a more active role and experiment with their ideas. This change resulted from listening to the student tapes, as the students commented that they liked doing practicals and experimenting with their ideas but with the assistance of the teacher to enable them to “own what they’re doing.” In the second survey in December 1994, Craig wrote that in science he now covered half of a topic in class and then the remaining half is student choice and he finds that the students are more motivated as “this is far more effective and I get better work, more enthusiasm out of 95% of the students. There are still one or two in each class that still don’t do much. This system, however, allows me to keep an eye on them far more.” (Survey 2, December, 1994, Qu. 2)
(e) Craig’s beliefs about priorities and constraints in the context

At the beginning of the study, Craig believed that a constraint in the operation of schools was a timetable because it hindered his flexibility in lessons. For example if a student asked a topical question he would prefer to answer it or even show the students something rather than stick to a rigid timetable. Five months later in May 1994, he was being less prescriptive in the way that he organized practicals for students and was giving them more open ended tasks. This problem solving approach, however, was creating a dilemma for him because of restrictions on how much time should be spent on other topics in a program and some may have to be left out. The same difficulties existed 19 months later in November 1995, as encouraging students to experiment with their own ideas resulted in dilemmas about how much time to spend on topics. In addition he mentioned that another concern was the area of assessment. He explained that his teaching had changed to promote more self learning but his assessment procedures were inconsistent with this approach and still focused on recall of factual knowledge. The science teachers are intending to address this issue in 1996. Data regarding Craig’s beliefs about constraints in the context are shown on the next page.
• Data regarding Craig's priorities and constraints in the context

December 1993

That is the trouble with schools, you need a timetable. You can't go without a timetable but a timetable restricts people and some tend to say "Right this is what you are going to do" and they get very rigid. I don't think that is necessarily good. If the kids are sitting there with a question, even if it is something they saw on Beyond 2000 on TV, they might ask a question and if you have the answer, I can't see the point of not giving them the answer. Even if it wastes 15 or 20 minutes... I suppose in content you have wasted a period of your program but whether that is actually wasting it in their education, I don't think it is. They probably would get more out of that period than what they would have out of a lot other periods because you are answering a question that interests them.

(Int. 2, Dec. 1993, TU 71-78)

May 1994

There are problems in problem solving. This thing about doing four weeks with this topic and four weeks on that topic is crazy because you can't. You give them a problem they can't solve and there is a problem you've got to solve. It might take them three or four attempts, it might them two weeks. So you get cranky with this slide of time thing through the year and you're stuck, you can't do it... You've really got to have less topics in the year to cope with the fact that instead of four weeks it's going to take six or eight. But then you've got the problem that you might not be covering all the material you want. But you've got to make I think a decision on what you want to do. You either cover a topic and get them to do the practical stuff and all the problem solving skills and get it down pat and have the kids do it properly or you can still cram it into time blocks you're not going to get done properly. (Int. 4, Dec. 1994, TU 84-89)

November 1995

Time is the enemy, I believe, of this type of teaching. And if you constrain yourself to time, as each topic has taken six weeks or four weeks, I don't think it will be very successful because you won't be able to extend the kids out in such a way that they can try and fail, try and fail, even though I don't like the word "fail". The time is the evil enemy here. Anyway, as I assessed my thoughts against the students, I changed them mostly in practicals... Because even though our ideas are changing, the assessment is still based on a lot of content stuff. In all I don't think the two match very well. And we are grappling with that at the moment. I think next year, that will be our main goal to try and revamp the assessment system to make it more relevant to what we have been doing.

(Personal Statement, November, 1995)

In short, Craig was concerned at the beginning of the study that time was an issue when he diverged from a set program in order to address questions raised by the students that may not be on a designated topic. A prescriptive program was still a constraint on his practice and creating dilemmas when he changed his teaching to encourage more problem solving as he was being forced to leave some topics out. Furthermore, his assessment procedures were not consistent with his changes in his teaching which is an issue to be addressed by the faculty in 1996. In the next section I present a summary of my interpretation of Craig's change in his understanding of his practice followed by views from one of his students from an interview in May 1994.
Craig’s understanding of his practice as an “open learning” teacher

There was a substantial change in the way Craig understood his practice during the program. In particular, the student data challenged his beliefs about the way his students learn and he changed to incorporate “more problem solving rather than instructional activities” in his practicals. In addition, he wrote in December 1994 that he preferred to cover 50% of a topic with the class and then allow students to choose an area to concentrate on for the other half of the topic. In November 1995, Craig stated that his teaching incorporated more “open learning” so that students could research topics that interested them rather than him teaching the whole class in a practical:

And I'd rather have more open learning, where kids go off and do research on particular topics and research things that they are interested in that topic, rather than set them a different set of outcomes to achieve. There may be some things that I see is important to them that might help them in the future when they're trying to research some topics. There is some background information that they might need to know no matter what they're trying to research and you'll never get away from it. I think that's very important. (Craig’s Personal statement, November 1995)

He also changed his beliefs about students encouraging them to “own what they are doing” and to experiment with their ideas rather than simply following his instructions. This provision for student choice was supplemented by a change in the way he expected students to record their experiments. Instead of students following a traditional “problem, method, results, conclusion” format, he encouraged students to write in a less structured to be consistent with their new writing policy (see Appendix R). He noted that “it’s messy in some cases, but I get a much better understanding of what is in the student’s mind. Therefore I can evaluate the success of the activity better and also it has allowed for stages/speed of learning to be more individual” (Survey 2, Dec. 1994, Qu. 3). In contrast, his beliefs about subject matter were justified by the student data, as he always believed that it was more important for students to learn problem solving skills resulting in an understanding of science concepts than isolated facts. Nevertheless, students need “some background information that they need to know no matter what they’re trying to research.” A diagram representing my interpretation of the change in Craig’s understanding of his practice is shown in Figure 15.
Figure 15. Summary of My Interpretation of Craig's Change in his Understanding of his Practice
A student’s view on Craig’s teaching

In May 1994, I interviewed one of Craig’s students to ascertain if he could notice any change in Craig’s teaching during the previous six month period. Although he could not remember any change in his teaching from the beginning of the year, he was able to support that Craig was providing students with options in their topics and using a “jigsaw” procedure. I asked Loughran about the topic of “Evolution” as Craig had spoken about that topic in previous interviews:

Garry: So how did you go about the evolution topic?

Loughran: We did organisms, cells, fish, amphibians, and monkeys. You could pick and choose, fossils, human evolution. I got a couple of pictures of skulls together in terms of pictures.

Garry: Did you do it by yourself or in pairs?

Loughran: We were doing it in pairs.

Garry: How did you know what to do?

Loughran: He gave us a sheet to do and you choose a letter and you look up the letter and it tells you all the questions like “How did evolution start? Where are we on the evolution list and all that,” it was pretty straight forward.

Garry: What do you mean the letter?

Loughran: You could do human evolution, the evolution of any animal or choose all the way to F, and I chose human evolution.

Garry: How did you know where to start?

Loughran: I just started from scratch because I did not have anything else.

This supported Craig’s comment that he was giving students some choice in their activities encouraging them to be more responsible for their ideas rather than directing them in prescriptive experiments. In the next section I present features of the professional development program that Craig identified as influencing his understanding of his practice.
II. Features of the Professional Development Program

In December 1994, 18 months after the program started, Craig was interviewed by an educational researcher who had not been involved in the program (see Appendix I for interview schedule). During the interview Craig commented that the program had helped him to understand his practice as “I think the thing that has helped me most of all was the fact that we could sit down and listen to what the kids said.” In the last question in the interview he was asked if he had any general comments. He replied:

Right, well I think in the six years I've been teaching and all the professional development and all the things we've had, the days we've had off, the pupil free days, it's [professional development program] probably been the most useful thing I've ever done. Like pupil free days are great cause the kids are at home and you get a day off basically. But some of the things that we do I'd just as soon come to school and have the kids here because they [professional development days] bore me shitless or I think they're a waste of time or going from one school to another, you do the same thing again. And if you don't necessarily agree with what you're doing on the PD day, then it is a very boring day. But this is the most useful thing I've ever done mainly because there's a point to it and I could see the usefulness of it. (Int. 4, Dec. 1994, TU 162)

Several times during the study Craig was asked to comment on features of the program that may have enhanced or constrained his understanding of his practice. First, I present features of the program that Craig's identified as constraining his understanding of his practice. This is followed by features of the program that enhanced his understanding of his practice supported by a model of his own learning that he sketched and explained at the end of the study showing a relationship between these features.

Features of the program that constrained Craig's understanding of his practice

During the study, Craig identified two features of the program that did not enhance his understanding of his practice which were similar to the features that David identified: (a) his reflective journal that he used at the beginning of the study, and (b) lack of time to reorganize teaching programs.
(a) Reflective journal
Craig commented that his journal that he used at the beginning of the study did not enhance his understanding of his practice because he used to forget to write in it, and then he would have to record three or four days of reflections which he found difficult:

> And I kept the journal up until about May. But after a period of time I tend to forget to do it here and there and in different places because you get to the end of the day and you’re thinking about, you’re not thinking about doing a journal, you’re thinking about doing something else and then you forget. Then there’d be a couple of days in a row that you’d forget and then you’d sit up and you’d think “Well now I’ve got to fill in three days worth of journal work”. . . . and in the end you sort of, I forgot and I got sick of going back and writing three days or four days worth of work. (Int. 4, Dec. 1994, TU 137)

(b) Lack of time for reorganizing programs
In his second survey in December 1994, Craig stated that all the changes that had occurred as an outcome of the professional development program, such as writing new programs, had been very time consuming and he needed more time for this, “I needed more time, days off, to program—a very complex set of changes needed more time.” (Survey 2, Dec. 1994, Qu. 2).

Features of the program that enhanced Craig’s understanding of his practice
At several times in the study Craig was asked to identify features of the program that assisted him in understanding his practice. He identified seven main features: (a) student tapes, (b) personal reflection and experimentation, (c) responsibility for interpreting data, (d) collegiality, (e) discussions, and (f) feedback from external facilitator.

(a) Student tapes
The student tapes provided the most impact on how he understood his practice because they gave him access to information that students would not normally tell teachers. In particular, Craig appreciated how the student data had been grouped onto theme tapes to address “aspects” of student learning:

> I think that the central point of the program for me, the crux of it, was the fact that Garry last year interviewed the kids. Now I
think we, David, Geoff and I, could have sat there with Garry for the next five years and said “Right this is what we think we should do”. But if what we think should be done, and what the kids perceive should be done are totally different, then it doesn’t matter how much time and money you spend on it, it’s a total waste of time. So the fact that he interviewed twenty kids last year and compiled them all into sets of different aspects of what they said, and us listening to them, I think that was probably the most important thing and had the most impact. (Int. 4, Dec. 1994, TU 118)

In particular, Craig highlighted that some of the tapes challenged his understanding of his practice while other tapes reinforced what he already knew. For instance the practicals and responsibility tapes informed him that students preferred him to organize experiments differently and the writing tape confirmed that getting students to copy notes from the board was a waste of time:

Well I would say listening to them, the practical one, and probably the responsibility one. The fact that they wanted practicals but what they wanted to do was slightly different than what I've been doing and the fact that they wanted to have more sort of, be involved more in the process of doing the practical rather than being told everything. I think those two points are probably the most important points that I got out of the whole thing. A few of the things, for instance the prior knowledge one I already knew about that. I knew for a fact that writing copious notes on the board was a waste of bloody time. (Int. 3, May 1994, TU 109)

(b) Personal reflection and experimentation

An important part of the program for Craig was being able to “assess” his own ideas compared to the students’ ideas on tapes as “it is the confrontation between their ideas and your ideas that makes you think about the whole thing” (June 1995, Appendix L). Craig then considered ideas from what he learned from listening to the student tapes and experimented with his practice followed by more reflection to “assess” the benefit of trying the ideas in his teaching, but there was always room for improvement:

Now is my opportunity to try and implement what I believe I learnt from the students, and this is an evolving process and it's taken a few go's, and a few failures and a few successes... I assessed or reassessed why it was good, why it was just okay or why it was a bit of a dud. And reassessing, it gave me some idea of why, why it was good, why it was
okay or why it was a dud . . . and I don't think, it doesn't matter whether you've done a good job, an okay job, or not successful job, there's always room for improvement because even when you're successful, practicals or successful lessons or topics or whatever, somewhere down the track even though you might think about it, you'd probably find something to improve it. (November, 1995, Appendix N)

(c) Responsibility for interpretation of data

Craig thought that it was beneficial that each teacher could make their own interpretation of the student data and consider his options for practice:

The second thing is the fact that we took that information and each of us saw it which ever way you wanted to. But all of us I think saw things in it that we were doing already. But I think we all saw things in it that we saw that we probably should be doing and therefore had to change. It is not a program, like one of the things, sitting there listening to the kids, now we knew who the kids were by the sound of their voices. And we knew for a fact, sometimes they were making comments about things that happened in the classroom and you knew for a fact that the comments were about us. (Int. 4, Dec. 1994, TU 176)

(d) Collegiality

Craig reported that the collegiality was very important in the process of trying to change teaching. In particular, although he identified the student tapes as the “crux” of the program, the tapes were very confronting and he thought that the program would not work unless all three teachers wanted to be involved:

It's very confronting, it's very personal, you have to look inward at what you do. And you see, what you see is what you see. If you look inward and you see right there's a problem, you can do one of two things about it. You can say, “Well I'm not going to worry about it” or you can say “Right I'm going to do something about it.” I think the fact that the three of us were quite happy to listen, take whatever was thrown at us, and then go and try and correct it was the only reason it probably worked. Even if one of us, like there's only three of us, if one of us had said “Right, I don't want to be involved in the program” I don't think it would have ran very well. (Int. 4, Dec. 1994, TU 180)
(e) Discussions
Craig thought that it was very important to be able to share ideas with colleagues, "If you don’t talk to colleagues to try and improve what you are doing, then you’ll sit in a hole and never go anywhere. So you’ve got to be confident enough to speak to them" (November 1995, Appendix N).

(f) Feedback from external facilitator
Craig identified that he appreciated discussing his ideas with someone besides Geoff and David because he could bounce his ideas off me which generated his thinking:

And I think your role Gary was extremely important. In some ways, I was a bit disappointed that you were not as accessible in the latter stages of the program as compared to the beginning. It was as the person who came in and talked to us about it, you're someone that we could speak to and tell about what we had achieved. It's alright David, Geoffrey and I speaking about things, talking to someone sort of outside our little trio, bouncing things off and you actually ask questions that I may not have asked myself. It helped generate thinking and enabled us, or me anyway, to get my ideas out to someone and discuss them with someone sort of external from the three of us working in the school. (November 1995, Appendix N)

Craig’s model of his own learning in the program
In November 1995, 29 months after the professional development program commenced, I faxed a request to Craig asking him to consider some examples of change in his practice as a result of the program, and if possible, to sketch a model showing a relationship between the features of the program that influenced the process. Furthermore, I asked him to describe his model by audio-recording an explanation and posting it with the diagram to me in Canada. The purpose of this request was to ascertain if he could conceptualize a model of his own learning as a result of the program, and to identify if there was anything in common between the features of his model of his own learning and the three principles of teacher learning, awareness, alternatives, and a community learning environment that underpinned the proposed professional development model shown in Figure 9. The full transcript of his personal statement in which he explained his model and discussed an example of his changed practice is shown in Appendix N. In the transcript I
have placed headings in bold that correspond to particular features of his model but have not altered the sequence of statements. On the next page I provide excerpts from Craig's transcript that describe his model of his own learning followed by his sketch of the model on the subsequent page. The first quotation corresponds to the top part of the model and describes how the learning process started. The second quotation corresponds to the center and lower parts of the model that describe what sustained the process.
• Top half of the model: Features that started the process (points 1-4)
The “crux” of the program for Craig was comparing his ideas on his practice that he generated before the program with the students’ ideas on the tapes:

On point one I have my original ideas, they’re the ideas that I came into the program with, before I’ve listened to the kids’ tapes, before I’ve spoken to you or Geoff and David. Point two is the students’ thoughts from the tapes that we listened to. And I think that was probably one of the most profound parts of the whole program for me anyway. It was sort of the crux to the whole thing, without the students’ tapes basically I don’t think it will work very well. Three is me listening to the tapes. After we listened to the tapes, we get to point 4, this is where I assess my thought against what the students thought. In some ways there were parallels, in some ways there were vast differences particularly in the aspects of practicals. My thoughts on writing and so on were mirrored somewhat by the kids, but my practical ideas were in some ways vastly different. I’ve changed the way in which I do practicals.

This is similar to the interplay between the principles of awareness (his own ideas) and alternatives (student tapes) shown in the center of Figure 9.

• Center and lower half: Features that sustain the process (points 5-10)
He experimented with the ideas that he had learned from the students, “reassessed” them, discussed ideas with colleagues leading back to further experimentation in a “never ending or evolving process.”

Now is my opportunity to try and implement what I believe I learned from the students, and this is an evolving process and it’s taken a few goes, and a few failures and a few successes. . . . And reassessing, it gave me some idea of why, why it was good, why it was okay or why it was a dud. But I’ve got all these things going to one box 8, called improvements. . . . If I am struggling to find an improvement, particularly on a topic that I might not have a great deal of background in, then I’ll look towards David and Geoff. . . . If you don’t talk to colleagues to try and improve what you’re doing, then you’ll sit in a hole and never go anywhere. So you’ve got to be confident enough to speak to them. I think that’s very important and that’s point 9.

Craig experimented with his ideas, reflected on his successes and failures, and conferenced with the others teachers similar to the community learning environment shown in Figure 9.
Figure 16. Craig’s Conceptualization of a Model of his own Learning

No end point — continually evolving process
No crop of students are the same — you will have to continually reassess/re-evaluate your success & failures.
Furthermore, Craig's learning, which started with his personal reflection by “assessing” his thoughts in light of the student data, led to experimentation with his ideas followed by discussions with colleagues in a cycle:

It's a continually evolving process like a cycle because no group is the same. And you have to continually reassess and re-evaluate your successes and failures. I don't think you ever get to a final point where you know everything. Just as kids change, your ideas will have to change along with them. So it's a continually evolving process.

In summary, there are similarities between Craig's model of learning and the proposed professional development model shown in Figure 9. First, the features that Craig identified as assisting his understanding of his practice are consistent with principles of the model. For example, his “assessment” of his thoughts in light of the student tapes is similar to the interplay of the principles of awareness and alternative perspectives as shown at the center of Figure 9. Using his ideas generated from listening to the student tapes, he experimented with his practice and discussed ideas with colleagues which is similar to the conditions of responsibility, approximation, and feedback in a community learning environment. Second, the features of the program that Craig identified did not act in isolation. For example, he argued that his learning was like “a continually evolving process like a cycle” of listening to the tapes, trying ideas, assessing his thoughts and discussing ideas with colleagues. Hence his learning was not attributed to one feature, but several interconnecting features which is consistent with how the principles of the model are interrelated as shown by the spider web in Figure 9. There are, however, differences between Craig's model of his own learning and Figure 9. For instance, Craig did not identify all the conditions of learning, although experimentation was an important feature of his model, and the features are not in the same configuration as the principles in Figure 9. Craig, did, however, show an arrow linking his discussions back to “trying to put into practice what I have learnt from students” and wrote at point 10 on his model that this cycle had “no end point—continually evolving process, no group is the same.” At the end of the study, Craig read a draft of this chapter and wrote a response to my interpretations which is shown in Appendix Q. He stated that the “the whole process is a never ending one with students coming and going” and described the process of change as “dynamic”. 

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CHAPTER 7

THE CASE OF GEOFF

Overview

This chapter addresses the two research questions for the case of Geoff. Part one focuses on the first research question and is presented in three sections. First, I explain how Geoff understood his practice at the beginning of the professional development program including influences that shaped his understanding. Second, I analyze his beliefs that support his understanding of his practice from data collected at different times during the study. In this analysis I use categories based on five beliefs that Barnes (1992) contends are the most significant for how secondary teachers' understand their practice. Finally, I summarize how Geoff’s understanding of his practice changed as a result of the professional development program and include a perspective on his teaching from one of his year 9 students using data from an interview conducted a year after the program commenced.

Part two of the chapter addresses the second research question concerning features of the program that Geoff identified as influencing how he understands his practice. First, features of the program that constrained Geoff’s understanding of his practice are identified. Second, features of the program that enhanced his understanding of his practice are identified supported by a model of his own learning that Geoff sketched and explained at the end of the program showing a relationship between these features. These features are compared to the three principles of teacher learning that underpin the proposed professional development model shown in Figure 9.

I. Geoff’s Understanding of his Practice

Geoff as a “reflective” teacher

At the beginning of the program in 1993, Geoff had been teaching science for 14 years and was at his third secondary school. His professional qualifications included a Bachelor of Science degree and a Graduate Diploma of Education. This was his first appointment as head of a science department and he taught general science to classes in years 8 and 10, and Physics to years 11 and 12. He
was a member of the New South Wales Science Teachers Association as well as being past president of the local branch of that organization for several years. His interests outside of school include astronomy and SCUBA diving. He stated that his own high school education in science was “excellent—enjoyed it thoroughly.” His expectations for his involvement in the professional development program were to “improve and clarify teaching methods and to look at teaching in relation to student learning” (Survey 1, Dec. 1993, Qu. 11).

Having reflected for a month on the reasons for the way he teaches his year 8 science class, Geoff was able to describe influences that shaped his practice over the last 14 years. He found his 12 month Diploma of Education to be “hopeless” in preparing him for teaching as he could not see the point of the educational theory being presented. In fact, when he heard his students on the tapes describing their negative learning experiences at school, it reminded him of his education degree, “It’s everything, everything the students say how they don’t learn or ways they don’t learn is exactly what the Dip. Ed. is” (Int. 4, Dec. 1994, TU 254). Consequently, when he started teaching, he modeled his instructional ideas on the way that he was taught science in his own high school education. He achieved in science lessons which were taught in a traditional teacher directed way and he liked this ordered approach:

I started teaching in 1979, 14 or 15 years ago. Looking back over my teaching, I mean I think the way I started is probably true about every teacher. They start their teaching, because there is not a lot of practical experience before you start teaching, you start on the basis of what worked for you when you were at school and you have teachers of you in mind when you were at school. Now what worked for me when I was at school, I mean I liked a sort of order and I liked knowing where I was going and the teachers that I liked were what we call traditional sorts of teachers, the chalk and talk type teachers. So basically when I started off, very much I was the center of the lesson. The whole agenda of the classroom and the whole agenda of the learning process was controlled by me, I have got no doubts about that. (Int. 1, Dec. 1993, TU 11)

He stated that this traditional style of teaching dominated his instruction for the first ten years of his career. In addition, professional development courses

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that he had attended during this time had little impact on his understanding of his practice:

Much professional development is a waste of time. The most useful development comes through close contact with teachers and students within a school. One of the great difficulties within the present models of professional development is the lack of a suitable structure that encourages reflection and development. Most courses assume that teachers want to change—perhaps courses need to establish this and look at long term change. It could only be an improvement.
(Survey 1, Dec. 1993, Qu. 21)

During those first 10 years of teaching, he often reflected on his practice and subsequently changed the content of what he was teaching to suit different classes. During the last four years, however, he has begun to question not only what he teaches, but how he teaches:

In the past I have always been reflective about my teaching. Whereas before I would say “All right that lesson didn't go so well so what can I do next time? How can I alter it so it will go well or how can I alter what I write on the board or what experiences I give them?”, all that sort of thing. Instead of doing that, what I have started to do is to question and reflect on how I teach it, not what I teach. So all those things have changed and I wouldn't say that I am in a crisis of confidence about my teaching, I think it is a really positive thing that I am doing. (Int. 1, 1993, TU 159)

This change in teaching was stimulated by his reflection concerning why some students fail in science which coincided with several professional development courses about learning styles and constructivist views on learning:

Of course then we come to the fact that there are kids who don't do very well and kids that you fail and kids that don't like science and all this sort of caper. I started to think all right why is that happening in the lesson? . . . I have always been in big high schools, you move them to a class where the level of expectation was lower and they could try and succeed so it becomes a self-fulfilling prophesy that they could go down to lower and lower levels until they found their level or they found the bottom level and still didn't succeed there. I started think about this and I started thinking about learning styles and more open ended teaching. (Int. 1, Dec. 1993, TU 11)
He now finds that he is in a state of flux as he attempts to change his method of teaching from being centered on himself to being more centered on his students. Furthermore, he has found this attempt to change "very uncomfortable" and he was experiencing dilemmas as he experimented with his teaching to create better learning opportunities for his students:

Now I think I find myself in a bit of a state of change and state of flux where I am struggling to change my teaching style from mostly centered on me to mostly centered on the students and much more catering for each individual student. And I think that maybe that is becoming my creed over the last two or three years. I don't think I have adequately encompassed it yet, I don't think there are many teachers that have. I don't know if there are any teachers that have, but certainly I am in a state of change right now. At the moment what I find is that with this change, I mean I am trying to find something that suits me and the kids but what I find very uncomfortable about it, and I think that this would probably be true of many teachers that have taught as long as me, is that the sudden movement of the shift from me to the students and finding the balance, finding a good balance that works for the students is a real worry for me; and sometimes makes me feel uncomfortable because I still think I am doing a good job, and I still think I teach well, and I still think most of the students like coming to my classes and once again that is the feedback that I get. (Int. 1, Dec. 1993, TU 11)

He gave several examples of how he was trying to change his method of teaching by giving students more responsibility to conduct their own work rather than instructing them together as a class. For example, he stated that he had taught "The Human Body" traditionally three times every year for 13 years by presenting the topic in sections to the whole class at once so that all students would study one body system at a time. Recently, he organized it differently with his 8A science class using a jigsaw method and gave each of the students a system to become an expert in so that they could conduct their own research on that system and then discuss it with the class. Surprisingly, he found that the test results from the students were the best he ever had received before. This was a mystery to Geoff and a concern because he had less control over the process as he did not teach the class the same thing at the same time. In addition, he experienced some dilemmas when he taught this way because he was unsure about what the students were learning and at times felt like going back to his conventional teacher centered methods:
And to me at the time, I was really worried because it was an experiment because I didn't know if this experiment was working, and yet what came back at the end of the day was that the kids had got more out of it than they ever had with me sort of presenting the experiences one by one. I don't know why it worked, but it did work. I mean it probably works because the kids are doing their own thing, but that worries me strangely enough. . . . it worries me because I have so little control over whether something works or not. I have always felt before that if something failed it was down to me, and I could dissect it logically and say it failed because this happened. But with this process all the way through I was trying to think was this going well or was this not going well? And I just couldn't really analyze it and I didn't know if it was going well or not, so if it wasn't going well I thought maybe I should chop it off half way through and retreat back to what I knew best but I couldn't work it, so I followed it through to the end and it did work well. Now how do you figure what you present to the kids is going to work or not going to work? (Int. 1, Dec. 1993, TU 15)

Another concern for Geoff was that he still wanted some structure in his teaching and it worried him that it may become known to parents and other teachers that students in his class do "ad hoc experiences".

He gave another example of how he had experimented with his teaching in his year 10 class. Traditionally he taught "Ecology" to the whole class and he would direct them in a linear sequence through content in the topic. Only a few weeks prior to the first interview, he decided that the class would study a stream near the school and that he would divide the class into groups to study different ponds that contributed to the creek. At the time he did not think this would be very successful and wrote in his diary "Oh let's go down and get it over and done with." After the students had been investigating their own ponds for three or four lessons, he found that they "got more enthusiastic and they were actually doing work. . . . they were actually picking things out of their ponds and they had the idea of comparing the stream" (Int. 1, Dec. 1993, TU 19). Moreover, he found the interest of the students surprising as it was at the end of the school year when year 10 students are usually unmotivated about their school work.

During this first interview Geoff described the type of learning when students are given responsibility for conducting their own investigation compared to being directed as a group in a conventional style. He used the
term "peripheral" to describe this learning when students are given responsibility to conduct their own investigations in groups as opposed to copying notes from the board or book. This contrasted with his conventional teaching style in which he directed students in their investigations like using a recipe for cooking:

Well I probably think that from my own perspective, I think it works because the kids were doing their own thing. I mean they were investigating for themselves and I saw, I think I see now that kids as they do that, they sort of pick up peripheral stuff and things that they wouldn't pick up in the classroom. They don't pick up anything by writing notes I have decided, nothing peripheral and probably a minimum of what is written on the board. The peripheral stuff they pick up is what they each get out of their set experiences. But in the past, those experiences like practical experiences have been with a definite beginning and end like a let's cook tea type recipe. There was a beginning and there was an end and so I mean and if they didn't reach the end they just said "Oh it didn't work I should have reached that end". So we are in a bit of a transition stage. (Int. 1, Dec. 1993, TU 31)

In the follow-up interview the next week, Geoff explained his meaning of the term "peripheral" as the way students learn when they take their own pathway to achieve a specified goal. In particular, Geoff found it surprising that students followed a different path to the way he anticipated in their investigations and "I found, and this was a great revelation to me, that not all kids think the same way as me and follow the same logic patterns as me. . . . I find the more independent a kid becomes in terms of learning, the less likely they are to follow the process that I want them to" (Int. 2, Dec. 1993, TU 29). He realized, however, that students were learning more by being responsible for their ideas used in their own investigation but was puzzled by the reason.

In summary, Geoff claimed that he has always been a "reflective" teacher during his 15 years of teaching. At the beginning of his career, education coursework in his Graduate Diploma of Education and inservice courses had little impact on this understanding of his teaching practice. Conversely, his "apprenticeship of observation" (Lortie, 1975) strongly influenced his understanding of his practice for the first 10 years of his career assuming that what worked for him in secondary school would also work for his own students. When he reflected on his practice during this time he
often adapted *what* he taught to suit different classes. During the last four years, however, he began to reflect on why some students fail in science and had become aware of differences in student learning styles. Consequently, he began to question *how* he was teaching and was experimenting with his practice by giving students more freedom to explore their own ideas and conduct investigations that interested them. He was, however, experiencing some dilemmas about this change because he had less control over what students were learning and at the same time was surprised that not all students think the same way as he did. At the beginning of the professional development program, he described his teaching as being in a state of "flux" as he attempted to change his practice by giving students more responsibility to control their learning in science lessons.

**Geoff's beliefs that support his understanding of his practice**

Five related preconceptions or beliefs about teaching have been identified by Barnes (1992) as the most significant for how secondary teachers understand their practice: (a) nature of their commitment to teaching, (b) beliefs about subject matter, (c) beliefs about student learning, (d) beliefs about students, and (e) beliefs about priorities and constraints inherent in the context. In this section I use these as categories to analyze Geoff's beliefs from data collected at different times during the study. By comparing how he frames his beliefs over time, I make some conjectures about change in Geoff's understanding of his practice during the professional development program.

(a) *Nature of Geoff's commitment to teaching*

Geoff has been committed to his teaching since he started in 1979. At the beginning of the program he described how he "loved" the job and how he maintained his interest in teaching over 14 years by being prepared to change and try new ideas. Five months later in May 1994, he stated that the professional development program had given him more options for change and reasons for why he should change, "Like before I had this notion that I had to change things but now, now I know why I am changing it and I have much better options of what I want to change it to" (Int. 3, May 1993, TU 41). In particular, the previous three or four months of the program had given him a "knowledge base" about student learning which reinforced his need to
change and develop. Seven months later in December 1994, he explained that he was "much more reflective now" because of the program and he was still prepared to change and explore ways to do this. Data collected during the study related to Geoff's commitment to teaching are shown below:

- **Data regarding Geoff's commitment to teaching**

  **December 1993**
  I love teaching. It is the best job I could possibly have done. I don't think there are many people who could say that. I feel really enthusiastic about my teaching. And he said "How do you keep your interest?" and I thought "Well it just is interesting." But I think how I keep my interest is that I am always prepared to try a change and see that there are always better ways of doing things and stuff like that.
  (Int. 1, Dec. 1993, TU 163)

  Teaching now is much harder and much busier than it was for me eight years ago. People laugh at that, other teachers laugh at that and say "How can that be?" but if you change your teaching style and you do this and you sort of lose a bit of, it is much easier to be the center of the lesson and control the agenda, heaps easier.
  (Int. 1, Dec. 1993, TU 115)

  **May 1994**
  I'm much more open, as I said before I have a much bigger knowledge base from it [the professional development program]. . . about how the kids are learning and what the kids understand by their learning and where the kids are coming from in science. I guess before, I guess you could say it was from my own gut instincts. . . I mean I think I said that on my first tape and I was trying to do something about it but it was much more a shot in the dark in those days. The last three or four months have been real eye openers for me in terms of what I was trying to do, why things were successful, why things were unsuccessful and it reinforced my need to change and to develop. I mean it reinforced some of the things I was doing were right just from my gut instinct.
  (Int. 3, May 1994, TU 45)

  **December 1994**
  The course [professional development program] has crystallized my ideas about what is good science teaching. It has confirmed some aspects e.g. students learn by doing, but it [professional development program] has extended my knowledge of why I am doing things. I am much more reflective now about how successful my teaching is and also more aware of real learning by the students. Within the classroom I think my teaching has moved away from what I am doing and expect and more towards the students being the center of the process. I am looking more at where I can go from here. As a by product, I look more critically at inservice courses!!
  (Survey 2, Dec. 1994, Qu. 1)

In short, Geoff has always been committed to his teaching and he maintained his interest in his career because he was prepared to "try a change". The professional development program did not change his commitment to his teaching, but assisted him to maintain his commitment by informing him about his practice. Hence the program "reinforced my need to change and develop" by providing him with "knowledge of why I am doing things".
(b) Geoff's beliefs concerning subject matter

When he commenced his career as a teacher, Geoff thought that science was a "huge body of knowledge," but this view changed as a result of his 14 years experience as a secondary school teacher. Geoff now believed that it was more important for students to develop an ability to learn by seeking information leading to understanding. Twelve months later, his view of subject matter had broadened, because he was becoming more aware of the importance of the role of "context" in what the students were learning by "getting to an end point while they're doing something else" as shown below:

• Data concerning Geoff's beliefs concerning subject matter

<table>
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<tr>
<th>December 1993</th>
<th>December 1994</th>
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<td>My initial view was that the science curriculum was a huge body of knowledge and skills that had to be transferred to the student. I now think of it as a much smaller body of knowledge and skills to be &quot;learnt&quot; and a more difficult side of teaching is to develop a student's ability to learn, to seek out information to &quot;like&quot; science and to see its use and how it works. (Survey 1, Dec. 1993, Qu. 19)</td>
<td>I think as time goes on, and I've got a couple things up my sleeve and I'm going to add more and I've got different ideas. That more and more of my teaching will become much more, well a contextual type of thing. Where the students are getting to an end point while they're doing something else. But I mean, the thing is now that the kids are much more with me, and I am much more aware of kids so whenever I plan, and this is the bottom line, whenever I plan something I try to plan it and do something so that the kids learn. Not so that I give them information so the kids learn, that's a big difference. I've really come to understand that heaps better... There is no key, there are several keys. It is not that I've got to prepare a good lesson where I give them information, that is not the key. The key is just one of several... I think at the end that they have a clear framework to reflect on what they've learned, alright, a clear framework that at the end you can come back and bring it together and say alright, well let's see guys, let's see what we learned. (Int. 4, Dec. 1994, TU 258-274)</td>
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Science is investigation leading to understanding and further investigation. This investigation can be random trial and error, accidental discovery or "scientific investigations". All this leads to explaining the world in our terms. I think of science as a process rather than a body of knowledge. It is the process that drives science on. (Survey 1, Dec. 1993, Qu. 20)

In short, Geoff's beliefs about subject matter changed during the program as "context" was becoming much more important for his teaching. This was because he was more "aware" of the students and was able to plan for their learning. In this regard a good lesson was not just presenting information, but involving students in learning and having a clear framework to reflect on what they have learned at the end to bring it all together.
(c) Geoff’s beliefs about student learning

During the last few years, Geoff has been concerned about why some students fail in science and has been reflecting not only on what he teaches, but how he teaches to improve student learning. At the beginning of the program in December 1993, he was asked to explain his views about the way that students best learn. He believed that student learning in science was related to two main factors—enjoyment and achievement—which were interrelated. Furthermore, these two factors were addressed when he gave students freedom to explore their ideas. So he had been experimenting with his teaching by setting goals for students but allowing them to use their own ideas to devise and investigate their own procedures. However, this type of teaching involved more “risks” in terms of what he thinks students achieve:

And so my teaching has become riskier in terms of management and in terms of what the kids achieve. Now I guess I know inherently that is the case, it is always the case if there is freedom to manoeuvre within these parameters that you set then kids will enjoy more. What science teacher hasn't been doing chemistry prac[tical] and created three different sorts of chemicals and the kids come up and say: "What will happen if I mix all the chemicals?". And under the old system I would be rigid and say "No way, that is not part of what you are trying to achieve. I gave you an aim and you are trying to achieve a set goal, now it has got nothing to do with mixing these three chemicals so you just go along with that". However, now I am more likely to say "Well let’s see what happens and let’s find out and even if something interesting happens or if nothing happens you can put it in the practical that you did that. (Int. 2, Dec. 1993, TU 13)

Five months later in May 1994, his beliefs about the importance of enjoyment and achievement had been reinforced because one of the student tapes addressed “enjoyment” and another addressed “responsibility”. Furthermore, the student tapes provided him with an understanding of other conditions or factors that influenced learning which he now described as “a subtle interplay of many factors.” Data collected during the study related to Geoff’s beliefs about student learning are shown on the next page:
Data regarding Geoff's beliefs about student learning

December 1993
The best way to learn science is when they enjoy science. Kids always learn something when they enjoy it, also something that they can succeed at. If they feel they are getting success then kids will move on. Now whichever way you teach it, I think that is the crucial point, that they feel good about a subject and they feel as though they are achieving something in the subject. Now I guess when you think about it, if you set a lesson so the kids are working more or less independently but you set goals that are achievable, then the kids are going to learn and they are going to enjoy it, you can't separate the two really.
(Int. 2, Dec. 1993, TU 11-13)

December 1994
Learning in science is problematic—there is a subtle interplay of many factors and the importance of each one will vary depending on the student. It is the teacher's job to try and create a climate that promotes learning for as many students as possible. If I were to sum up what is necessary:
1. Find out what students know and design work accordingly.
2. Create interesting experiences where students learn as they work through experiences.
3. Encourage students to explore and don't penalize for "mistakes".
4. Make it clear to students what they are trying to learn and ways to give them opportunities to show them what they have learned.
(Survey 2, Dec. 1994, Qu. 3)

December 1994
When I was reflecting at the beginning of the year, I realized there was something wrong with the way I was teaching. Not something wrong, but I needed to teach differently, probably yeah, there was something wrong. That students weren't learning as well as they could and all this sort of thing and that there was another way to teach. So I started to change. What I do, what I can do now at the end of the year is I can analyze what I'm doing far better, and why I'm doing it... And so I mean, now when I plan, when I plan to teach, I tend to think very carefully as I'm planning a unit, how can I plan it so that the students have got freedom to investigate? How can I plan it so that students can own their learning? How can I plan it so that all the sorts of conditions that we've talked about through the year are satisfied, as many as I can satisfy in any given topic.
(Int. 4, Dec. 1994, TU 5)

In short, Geoff's beliefs that enjoyment and achievement were important factors in assisting student learning were reinforced during the program and furthermore, his understanding of student learning broadened to include other factors as well, "Kids are going to learn when they enjoy and kids are going to learn when they achieve, they are my base beliefs. I don't think that has changed, but what's happened is that the whole, the whole structure is broadened and it's brought into it so many other things so that's changed my practice" (Int. 3, May 1994, TU 49). Hence, the student tapes justified Geoff's beliefs as they "reinforced what I was starting to do" and broadened his understanding of other conditions providing him with a "much bigger knowledge base... about how kids are learning" (Int. 3, May 1994, TU 41).
The result is that when he plans to teach a unit, he organizes the work “so that all the sorts of conditions that we’ve talked about through the year are satisfied, as many as I can satisfy in any given topic” (Int. 4, Dec. 1994, TU 5).

In December 1994, Geoff sketched a diagram representing a model of student learning as shown in Figure 7. In the diagram, he shows a relationship between students’ prior knowledge, their own investigation, freedom to act on results, reflection and practice, and teacher input at various stages of the process. Furthermore, at the center of the model is “Teacher Input” with arrows going to four aspects of student learning emphasizing the importance of the teacher’s role in interacting with students.

Figure 7. Geoff’s Conceptualization of a Model of Student Learning
At the beginning of the professional development program, Geoff believed that it was important for students to become independent learners. By May 1994, he was “more aware” of the need for students to “own ideas and being responsible for their learning.” As he had been informed about student learning by listening to the student tapes, he was thinking more critically about what the students need to encourage them to become independent learners. In December 1994, he was more analytical about student learning which had consequences for how he organized his teaching as shown below:

- Data regarding Geoff’s beliefs about students

<table>
<thead>
<tr>
<th>December 1993</th>
<th>May 1994</th>
<th>December 1994</th>
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<td>What I would really like to be able to get and I think this is the way we have to go, is to get kids in 7 - 10, if you do nothing else, get them to be good independent learners. Because this school if it is going to present to the community maximum flexibility and maximum opportunities for the kids in years 11 and 12, the kids have got to be independent learners because we have got to develop a curriculum structure that relies on the kids having flexibility to pursue things rather than to turn up to lesson A at a particular point and be given this. Otherwise we are not going to staff it because we are a small school. But besides us other schools are going into the same mode but I think it is even more important here because we have small classes. (Int. 1, Dec. 1993, TU 143)</td>
<td>I mean I’m much more aware of how important it is, the idea of pursuing their own ideas and being responsible for their own learning. I mean this is the critical thing that probably, this whole process that we’ve been through has made me so aware of...listening to the kids is a very powerful tool for change and then sitting down and going over it with everyone and talking with the others about what they did and why they did it and talking with yourself about, you know the whole aspects of the kids’ work and what they are saying. And I mean I can’t emphasize enough the idea that if you listen to kids, I mean this has been the big success for me, that they have a lot to say about how they learn and it’s just amazing what they tell you has a very powerful affect on you as a teacher provided you’re willing to listen. (Int. 3, May 1994, TU 45-47)</td>
<td>I am more analytical about the kids. I thought about which way does this kid learn, which way does this kid learn, does he learn by doing things, does he learn by writing things down? And I’ve been more analytical about the kids that way. Anyway, it worked like a treat and the kids were, I mean the things they did were just brilliant. Like before I would have just said copy this food web of the book and do exercises 4.3. So then they built up their own food webs and they got the idea and they need to know what a predator was, what a consumer was, what a producer was, all that sort thing. So that was part of their outcome and they all talked about it at the end. I made each of them produce a report so that the person down at the pond had to talk to the researcher and the scientific officer had to talk to the other two. (Int. 4, Dec. 1994, TU 39)</td>
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In short, Geoff’s beliefs that students needed to become independent learners and be responsible for their own investigations were justified as a result of
the professional development program. Because of the student tapes he had become more aware of the importance of students being responsible for their learning and was more analytical about how to do this. The consequence was that he had a better understanding of "what the students are getting from me."

(e) Geoff's beliefs about priorities and constraints in the context

At the beginning of the professional development program, Geoff had been experimenting with his own teaching and was encouraging students to pursue their own ideas. A constraint on this approach, however, was the existence of a prescribed curriculum in later school years. Although there was not a prescribed curriculum for years 7-10 science, there was a very specific curriculum for years 11 and 12. This created a dilemma for Geoff and he was experiencing a quandary because he did not have as much control over what the students were learning. Furthermore, he was unsure if the students were getting the "right" experiences in their 7-10 science classes to prepare them for what they needed to know for science in years 11 and 12. Also, by encouraging the students to explore their own ideas, this meant that topics run for a longer period of time and was a very hectic schedule as he helped the students in their investigations. This way of teaching required more lesson preparation and was throwing his lesson plans into disarray. By December 1994, the dilemmas created by a prescriptive curriculum were still present, but nonetheless he was now experimenting with his teaching of science in year 12 Physics by encouraging students to build a musical instrument rather than "going through it step by step." However, this was still "scary" for him as he was not controlling what the students were learning. Data collected from Geoff during the study related to the priorities and constraints in the context are shown on the next page.
In short, Geoff experienced a quandary when he experimented with his teaching. His concern centered on the dilemma created by encouraging students to control their learning versus the responsibility he had to prepare students for a prescriptive curriculum later in their schooling. This was “scary” for him, as he was unsure whether students were getting the “right experiences” to give them a foundation for years 11 and 12. Hence, he had to manage a tension to get the right “balance” in his teaching between encouraging students to “own” and explore their ideas versus what students need to know for a particular curriculum. In the next section I present a summary of my interpretation of Geoff’s change in his understanding of his practice as a result of the professional development program followed by views on his teaching from a student interviewed in June 1994.
Geoff's change to a "much more reflective" teacher

As a result of the professional development program, Geoff had developed a knowledge base about student learning that provided him with a "theoretical structure for learning, then it all adds up to a real base for your teaching I think" (Int. 3, May 1994, TU 47). Consequently, the program had provided him with a foundation for change as he had a better understanding of his practice. In December 1994, he wrote on his second survey that:

This course [professional development program] has crystallized my ideas about what is good science teaching. It has confirmed some aspects e.g. students learn by doing, but it [professional development program] has extended my knowledge of why I am doing things. I am much more reflective now about how successful my teaching is and also more aware of real learning by the students” (Survey 2, Dec. 1994, Qu. 1).

Geoff gave an example of how his teaching had changed from providing subject matter in a linear sequence to being more flexible based on his understanding of student learning. The example he gave was how he now taught “Astronomy” which was typical of the way the teachers have reorganized all the science topics in the year 7-10 curriculum into two sections: the first half of each topic addressed a common core of outcomes and then in the second half of a topic students can choose various electives based on their interests (see Appendix S for sample topic):

Originally when I taught astronomy, I set out a deliberate sequence and the sequence came from me. And what I did I had in my own mind that the sequence would start from the history of astronomy and from the earth and then build out from the solar system into the universe and try and show a structure. Now, for most parts, the way we would have done it, we would have had some individual assignments and things like that, but mostly we would have gone from one part to the other and we would have had notes and audio-visual and all that sort of thing. The notes I would have given them from the board, from overheads, that sort of thing. At the end of the six weeks or whatever it was, we would have a test, and every one of the kids in the class would have had exactly the same experience. Now, I'm doing it slightly differently. One of the ways that this [professional development program] has affected us is we've actually looked at our programs and we've made our programs center about a core of outcomes which are actually knowledge outcomes, not nearly as many,
I wouldn't have expected, no, I'll say it again. The core is much smaller than in the past that I would have expected students to learn. I think it's well that doesn't come out, it sounds like I'm compromising but I'm not. All right, I want to make sure that all the students have the same core experiences in our topics in year 7, that core of knowledge is centered around the earth. So the way I've done it now, each of the students specialize in one area. Some of them did eclipses, some of them did tides, some of them did the phase of the moon, some of them did the seasons, the lower ability kids did day and night. They each had to present a little play where they themselves became part, became a planet or so on, and then they presented that to the rest of the class. And the rest of the class had to ask questions about it and then I questioned them. And the other thing that the rest of the class had to do was they had to make up little diagrams and notes for themselves about what the students learned. (November 1995, Appendix N)

In addition, Geoff explained that because his teaching had changed based on the way students learn, that he has also changed his assessment procedures. This was in accordance with a new faculty policy as a result of the professional development program which the teachers are still refining in 1996 (see Appendix T for current assessment policy and the previous policy):

Anyway, I've thought a lot about the way they learn and then from there you've got to think a lot about assessment and what part it plays. And I've decided, because I think without the assessment you're not going to get the excellence, and really testing doesn't test for excellence. What testing does is sort of, it doesn't test what you've done or what you've learned. So the kids are going to present this to a panel and the panel is going to include, if they're available, their parents or another community member. Anyway, so this will be really interesting and also some of their peers and we're going to use that. They all get input into the final assessment. I'm pretty excited about that. (November 1995, Appendix N)

A diagram summarizing my interpretation of how Geoff changed his understanding his practice from a "reflective" teacher to a "much more reflective" teacher and his beliefs that relate to this change are presented in Figure 18.
Figure 18. Summary of My Interpretation of Geoff's Change in his Understanding of his Practice
A student's view on Geoff's practice

In June 1994, I interviewed one of Geoff's year 10 students to ascertain if she could notice any change in Geoff's teaching over the last six months. Geoff selected Loreena from year 10 to be interviewed because she was articulate about her learning in the first student interview. She recalled an incident when Geoff did not use step by step instructions in teaching science:

Yeah. I'm sort of thinking well this is different, you know this is a new way, they have to work it out themselves. And I'm sitting there, I'm sitting on the bench and I'm watching everyone and there might be four different groups on that wall and they're all doing it a different way. But all the results are the same and I'll come back see because they had to work it out themselves, they were almost forced, almost to take interest, it might sound weird, but they were all almost forced to. I mean, they knew they had to do it. I mean but if they really didn't want to I mean they could have complained, or they could have copied someone else. But the fact that Mr. Hastings believed that they could do it, and he didn't treat them like children and give them step by step instructions you know. He said, "Okay there's the ticker timer, there's that box, that electrical box thingy and you know here's a piece of tape, I want you to try and you know, work out the speed of something." And they'd all sit there and think "How the hell can you do this, you know using that formula, okay?" And you could watch them all do it a totally different way. But they, you watch them in groups and they'd argue with one another, "That's not how you do it," one would say and they'd pull the tape away. And another would say "Yes it is" and they'd say "No it's not you've got to do it this way".... Then all of a sudden they had to figure it out by themselves. And I took notice that the kids that had never needed to think before, all of a sudden started developing opinions and started interpreting and I didn't think that, I honestly didn't think that they ever could. That they were the sort of kids that wouldn't bother you know. And I started to listen to their interpretations and thinking, wow, well it's a bit different to mine but my goodness at least it's one of them, at least they've got one which before they never dreamed of having one. They would copy the teachers, they would know but they wouldn't learn.

Loreena's description of her learning in science supported Geoff's description that he was not providing students with as many directions and encouraging them to explore their own ideas. In the second part of the chapter I present features of the program that Geoff identified as influencing his understanding of his practice.
II. Features of the Professional Development Program

In December 1994, 18 months after the program started, Geoff was interviewed by an educational researcher who had not previously been involved in the program (see Appendix I for interview schedule). The first question asked Geoff if the program helped him in understanding his own practice. This was his reply:

Yeah, I mean it's been the most dramatic professional development program I've undertaken since I've started teaching and that's 15, going over 15 years ago so it's a fair way. In terms of, I think it's the first, although I am a reasonably reflective teacher, I've done more reflection on my teaching practice this year than I've ever done before and that's in my whole teaching career. And also the discussions and so on have meant that I have developed, I think, a far better understanding of what I'm teaching and why I'm teaching it and also how the students are learning. I'm taking far more notice of this because I've developed it myself rather than listening to an expert up front telling me how to teach. I tend not to respond very well to that like most teachers. (Int. 4, Dec. 1994, TU 3)

Several times during the study Geoff was asked to comment on features of the program that may have enhanced or constrained his understanding of his practice. First, I present features of the program that constrained Geoff's understanding of his practice. This is followed by features of the program that enhanced his understanding of his practice supported by a model of his own learning that he sketched and explained at the end of the study showing a relationship between these features.

Features of the program that constrained Geoff's understanding of his practice

Similar to the others, Geoff identified two features of the program that did not enhance his understanding of his practice: (a) his reflective journal that he used at the beginning of the study, and (b) lack of time for meetings.

(a) Reflective journal

Geoff thought that the journal which he was suppose to write in during the program to help him reflect on his practice did not work. The main reason being that there were often more pressing matters than writing in the journal:
We just didn’t have time to keep the diaries. I mean we would have four kids lined up outside the door with referrals and you’re thinking about letters home and you know some kid had a punch up somewhere or you know all that sort of thing. It’s just no way you could do it. The diaries always went to the bottom of the heap. (Int. 4, Dec. 1994, TU 124)

Geoff suggested that it would be far better to record his thoughts each week on a tape recorder which would be more manageable.

(b) Lack of time

Another weakness that Geoff identified was that the group meetings needed to occur more often, “The meetings need to be more regular, the situation where staff could get together once a fortnight and talk about the program would help.” (Survey 2, Dec. 1994, Qu. 2). In the group meeting at the end of 1995, Geoff stated that they were intending to have regular meetings every two weeks after school to discuss their practice as well as the occasional full day discussions.

Features of the program that enhanced Geoff’s understanding of his practice

At several times in the study Geoff was asked to identify features of the program that assisted him in understanding his practice. He identified eight main features: (a) student tapes, (b) personal reflection, (c) group discussions, (d) collegiality, (e) experimentation and feedback, (f) extended time frame, and (g) external facilitator/resource base.

(a) Student tapes

Geoff claimed that the feature of the program that had the most impact on how he understood his practice was the student tapes because they were so personal:

Listening to the tapes. I mean there’s always, I always had a sneaking suspicion, or I always had a gut feeling that things had to change but it’s listening to the tapes and listening to the kids themselves that has the impact. I mean you can’t ignore it, it’s sitting up in front of you, I mean it’s right in your face, to use a very American term, that’s right in your face and it’s very difficult unless you’ve got no, well it’s very difficult for me, I can only speak from personal experience, to ignore something that’s so personal. It is your
students talking about what they do in your class so I think you've got
to take it on board or else I mean as a teacher you're not worth much, I
don't think personally. otherwise you shouldn't be teaching in fact. If
you think what you do all the time is always right and what, and that's
it then there's only one way and that's your way then what are you
doing in the job? So it's up there in front of you and you've got to take
it on board and you've got to think about it and I have, and I do.
(Int. 3, May 1994, TU 53)

In particular Geoff nominated several student tapes that influenced how he
understood his practice—responsibility, trial and error, relationships,
interest/enjoyment, and prior knowledge. In May 1994, I asked Geoff what
the 16 student tapes represented to him collectively. He stated that the tapes
provided him with a knowledge base for his teaching replacing his previous
base that was linked to the way he was taught science in his own secondary
school education:

A model for teaching, no, a base for a model for teaching, a
base for a model for teaching. That's, the ideas that come from that,
what it does is it, I use this word a lot, it's up-skilled me alright,
in that I can, I've got something to go back on and think about how is
this going to, if I do something I think "Well how is this going to
affect the kids? How are the kids going to react to this?" And I can
go back and say well there's responsibility and the autonomy ideas,
they've really taken on board, I've taken on board sorry and they
really like it, okay that's important. This is going to give them that,
ok I can go it a go, that sort of thing. So it gives me a base to
work from, a base for change. . . . if I am going to set a model of how I
and still, like of my practice, my teaching practice, then I've got to have it
based on something, I've got to develop it from a knowledge base.
Now I could say alright before, what was my teaching based on? It was
based on the way I was taught alright. But I've come very much
around to the fact that how I was taught isn't how everyone learns,
that's because I have sort of a new, I guess you could call it a new
model, a new base to work my teaching practice on. (Int. 3, May 1994,
TU 121-123)

(b) Personal reflection

Reflection was important to Geoff and at the beginning of the program
he stated that he had "always been reflective about my teaching." However,
he stated that he had done more reflection in the first 12 months of the
program than in his whole career. Interestingly, in his written reply to
interpretations in his case study he stated that in hindsight, he was not "reflective" as he did not have access to an alternative view on his practice such as the student tapes:

Looking back it is obvious that I always had an ability to examine my practice but I had no knowledge base on which to work in my efforts to improve. In fact I was not reflective as I did not examine my practice and look at alternatives—rather, I changed my practice within the constraints of my own experiences and understanding of teaching and learning. The program gave me the motivation to look further, initially because of the power of the student interviews and the effect that had on my understanding of the effect I had on students' work and learning. As a result my knowledge and understanding have expanded considerably and my practice has improved. (March, 1996, Appendix Q)

(c) Group discussions

In their group meeting in June 1995 to conceptualize a model of the professional development program, the teachers identified that the central theme that they kept revisiting in their discussions throughout the whole program was "how do students best learn?". The most fruitful discussions were the three full day meetings and ironically, Geoff stated that they needed this break away from school for a chance to share their ideas:

The only thing is you only get a chance to really talk about it [teaching and learning] properly when you are out of the school and you are sitting down and it is a time thing. There are days like this and you can come back to it and refresh it so you don't have to worry about the year 11 meeting or the boss going on and that sort of thing. . . . you need to get out I think and discuss and when you discuss you sort of tend to reflect about the framework especially. (June 1995, Appendix L)

(d) Collegiality

Geoff thought that the trust relationship among the group was really important and needed to be established by encouraging teachers to experiment with their practice and then help them in a non-judgmental way:

I think the only way you could do it is if everyone feels as though they're working in a non-threatening environment . . . it can't be coercive, it's got to be completely voluntary and it's got to be done in the spirit that no one feels threatened. . . . And the only way you could do it is to build up a trust relationship. There's no way anyone coming
into the staff the first thing I would hit them with is you do part of this process. I would think I would let them teach for a year in the school this is just off the top of my head now, it would depend on personalities but teach for a year, build up a trust, a rapport, you know the going out and having a few beers together all that sort of thing, and see them fall on their face a few times and help them out and realize you that you’re non-judgmental, all that sort of thing. (Int. 4, Dec. 1994, TU 168)

(e) Experimentation and feedback

Geoff believed that it was important to get feedback on the ideas that he was trying in his teaching that were generated as a result of reflections on his practice in light of the student tapes:

You’ve got the motivation and you’ve started reflecting on your practice and thoughts from the student tapes and your own reflections. So you’ve started the process that maybe there’s things that you need to be done and then you take on board the ideas, then there’s change. You try out the change and then you get that feedback. Now, this is important. At the moment our structure is only for informal feedback, but I think it’s important that we have formal feedback so that we see what we’re doing right, what we’re doing wrong in terms of the kids, otherwise we abandon the whole situation where we’re trying to get feedback from the students. So I think that has to be built into our process, and that’s something I hope to do now over the next 12 months. (November 1995, Appendix N)

(f) Extended time frame

Geoff believed that it was important that the program continued over a long period of time and so the time frame was important:

It was over an extended time frame that was reinforced again and again you know. We’d go and then we’d have a meeting and then we’d look at certain things and we’d have a talk down in the staffroom and that sort of thing. So it wasn’t just go to the meeting, come back and sort of try a few things for a couple of weeks and then you forget all about it. (Int. 4, Dec. 1994, TU 106)

In his personal statement in November 1995, he stated that the program needed to be four years long—one year to start reflection, two years to try out ideas, and one year to consolidate the changes.
(g) External facilitator/resource base

Geoff thought that my role as a facilitator was important, not only to get the program running and gather the student data, but I gave them feedback in interviews and discussions and when needed, I supplied them with educational literature on specified topics to extend their ideas:

The other thing I thing that I thought was critical to this was Garry’s input, not just in the tapes. The actually input he had and he started the process rolling and talking to us and that. . . . He had the big picture and got us rolling. (June 1995, Appendix L)

Geoff’s model of his own learning

In November 1995, 29 months after the professional development program commenced, I faxed a request to Geoff asking him to consider some examples of change in his practice as a result of the program, and if possible, to sketch a model showing a relationship between the features of the program that influenced this process. Furthermore, I asked him to describe his model by audio-recording an explanation and posting it with the diagram to me in Canada. The purpose of this request was to ascertain if he could conceptualize a model of his own learning as a result of the program, and to identify if there was anything in common between the features of his model of his own learning and the three principles of teacher learning, awareness, alternatives, and a community learning environment that underpinned the proposed professional development model shown in Figure 9. The full transcript of his personal statement in which he explains his model and discusses an example of his changed practice is shown in Appendix N. In the transcript I have placed headings in bold that correspond to particular features of his model but have not altered the sequence of statements. On the next page I have provided excerpts from the transcript that describe Geoff’s model of his own learning followed by his sketch on the page after. The first quotation corresponds to the top part of the model and describes how the learning process started. The second quotation corresponds to the center and lower parts of the model and describes what sustained the process.
• Top half of the model: Features that started the process

Geoff's own reflections and interviews on his practice compared to what the students said about their learning on their interview tapes started it:

The thing that starts you off is the combination of listening to the students' tapes and having the opportunity to reflect on your own performance and to sort of put down what you think about teaching onto tape. Now, all of that was really important because it's like a starting point. It uses something to base what you're doing on.

This is similar to interplay between the principle of awareness (personal reflection) in light of alternative perspectives in the center of Figure 9.

• Center and lower half: Features that sustained the process

It is the "collegiality" and "working towards a common purpose" that encouraged him to consider views from several "inputs" that generate ideas to try in his classroom leading to a cycle connecting the different features:

But then the important thing was that it continued on over time and all the time we were coming back to these, we kept going back to these inputs that came in. And then other things came in from the side, your input, your views, things like that, all taken on board. The collegiality, talking to the others, working towards a common purpose that encourages you because you tend to lose the plot of it in the day to day hurly-burly. It's all important and the time to reflect and then the starting point of the student tapes and your own time for reflection, what happens then is you start to think about change. And then what happens is you look at change and then you get the feedback . . . from the students, how you feel it's going, from the collegiality again, from your colleagues talking it over and stuff . . . . And I think to a certain extent we've integrated it ourselves because we've taken on board these ideas, but the basis of it is that skeleton, that starting point—the student tapes and your own opportunities for reflection, and then the change, feedback, more reflection, change, feedback, that cycle all the time bringing in ideas from outside, from other inputs, from your colleagues, from you and so on. And I think if any of these factors had been missing, then it wouldn't have worked.

This is similar to the community learning environment in Figure 9 supporting personal reflection (awareness) in light of different "inputs" (alternatives) producing ideas for change with feedback from students, his own feelings, and colleagues leading back to further reflection on his practice.
Figure 19. Geoff's Conceptualization of a Model of his own Learning

Note: Important, it is a long term thing.
In summary, the features that Geoff identified in his own model of learning are similar to the principles of the proposed professional development model shown in Figure 9. For example, Geoff’s reflection on his practice in light of the student tapes is similar to the interplay between the principle of awareness and alternatives shown at the center of Figure 9. In addition, Geoff highlighted the importance of other “inputs” that produced “a knowledge base, I guess a research base to enact change.” Consequently, having generated ideas from the group discussions, he then experimented with his practice and received feedback from students and colleagues which is consistent with the conditions of responsibility, practice, approximation, and feedback in a community learning environment. Also, these features did not act in isolation. Geoff referred to the connecting features as a “cycle of change” because they were linked to a framework that made it different from other professional development programs:

So the whole thing becomes sort of a closed cycle of change where you start with the student tapes and you start to reflect on the various aspects that you practice and you bring in all these external influences and you bring them together in your head and try work out what you’re going to do yourself in a classroom. And the important thing about it is that, and this is where it is different to other forms of professional development and this is why it’s caused change, is that it is continually reinforced because it is ongoing and because it has this framework that we keep coming back to, we feel as though we’re part of a project and part of a process that’s ongoing and not short term. It’s not a stick a finger in the dyke here, stick another finger in the dyke here, learn about literacy here, learn about assessment here—it’s a whole integrated package. (November 1995, Appendix N)

There are differences, however, between Geoff’s model and Figure 9. For example, Geoff did not identify all the conditions for learning and the features that he did identify are not in the same configuration as the principles in Figure 9. Also Geoff did not sketch a spider web linking the features but he did emphasize that “if any of these factors had been missing, then it wouldn’t have worked”. At the end of the study, Geoff read a draft of this chapter and provided a written response to my interpretations which is shown in Appendix Q. In the final chapter I discuss the research findings across the three cases leading to conclusions from the study and implications for further research.
CHAPTER 8

DISCUSSION AND CONCLUSIONS

Overview

This final chapter is divided into four sections. First, I provide an overview of the research findings across the three case studies. The presentation of these findings is guided by the two research questions and claims have been written in italics to make them clearer to the reader. This overview is followed by a discussion concerning the purpose of the study leading to conclusions that are related to the research literature. Finally, I present implications of the study for practice and suggestions for further research.

I. Discussion of Findings Concerning the Research Questions

Research question one: How did the teachers understand their practice and in what ways did their understanding change as a result of the professional development program?

At the beginning of the study, David’s and Craig’s understanding of their practice were based on their taken-for-granted assumption that their students learn science in the same way as they did at school. Geoff’s understanding of his practice for the first 10 years of his career was also based on the way he learned science at school. At the beginning of the study, David had been teaching for one year and described himself as a “structured” teacher who organized his classes to provide students with “working knowledge” or “in-depth knowledge” in a linear order. He taught in this manner because he learned this way at school with teachers who structured conventional science lessons. Craig had been teaching for five years and described himself as a “fun” teacher who mainly organized practical classes for his students. He taught in this manner because he learned this way at school with a teacher who made science “fun” by organizing many experiments for his students and telling jokes. Geoff also based his teaching for the first 10 years of his career on how he was taught at school. He learned science with teachers who taught in a conventional manner controlling the agenda of the lessons, “you
start on the basis of what worked for you when you were at school and you have teachers of you in mind when you were at school” (Int. 1, Dec. 1993, TU 11). During the last few years, however, Geoff had been reflecting on why so many students fail in science and had attended several inservice courses about student learning. Consequently, he had been experimenting with his teaching by giving students more responsibility to investigate their ideas in science practicals and was surprised that some students think differently to the way he did. He was, however, experiencing dilemmas and was in a state of “flux” as he tried to change his practice because he was concerned that he had less control over what the students were learning.

The teachers’ taken-for-granted assumption that their students learn science in the same way as they did at school was not challenged by subjects in their Graduate Diploma of Education. They believed, however, that their practicum experiences were the most valuable part of their education diploma reinforcing their conventional views about teaching science. David thought that his 12 month Graduate Diploma of Education (Dip. Ed.) course was a negative experience, which he could have done without, and described the course as “a complete waste of time because I didn’t really learn much” (Int. 2, Dec. 1993, TU 97). His reasons were that theory provided in the education subjects did not match the complexity of a classroom setting and he did not learn in lectures. Craig also described subjects in his Dip. Ed. course as “a waste of time” because he could not remember any of the theory and he got told that lessons would be successful with detailed lesson plans, but he found many such lessons did not work in practice. Consequently, his belief that students learn by having fun in practicals was generated from reflection on his own school learning and reinforced by his experiences on his practicum, “it didn’t come out of the Dip. Ed., that came out of me thinking commonsense and what happened to me when I was at school and what I had seen on my prac[icum]” (Int. 2, Dec. 1993, TU 31). Geoff described his teacher training as “hopeless” in preparing him for teaching because he didn’t learn anything and when his own students on the interview tapes talked about their negative learning experiences at school, it reminded him of his Dip. Ed. course. The teachers, however, all claimed that their practicum with conventional teachers was the most valuable part of their teacher training.
because it reinforced their views about ways of teaching science that they were familiar with from their own experiences as students in secondary school.

The teachers claimed that the intended content of most inservice courses they had attended did not enhance their understanding of their practice. However, they valued opportunities at these courses to exchange ideas about their classroom instruction with other teachers. David claimed that inservice courses he had attended in his first year of teaching were “in most cases a waste of time” because the ideas proposed were often different to his regular practice and required too much effort and time to incorporate into his teaching. Craig stated that most teachers perceived inservice courses as “irrelevant or impractical” because these are often run by academics or seminar leaders who do not have much “credibility with teachers.” Similarly, Geoff thought that “much of professional development is a waste of time” because the courses “lack a suitable structure that encourages reflection and development. Most courses assume that teachers want to change” (Survey 1, Dec. 1993, Qu. 21). In particular, Geoff and Craig stated that they often felt negative towards “experts” who do not regularly teach in a school and present knowledge to them in isolation from the rest of their practice, “I looked at it and thought, 'OK, here's some ideas', but I didn’t think that actually, I couldn’t see any point to say ‘Oh I’ll try this way’ or ‘I’ll try that’ or 'I’ll try this’ and it’s all in isolation. There’s no great change in your teaching” (Appendix L). A point, however, made by all the teachers was that the most valuable part of an inservice course, which may not be part of the intended content, is the opportunity to exchange ideas with other teachers that is “more applicable and practical” (Craig).

There was a substantial change in how the teachers understood their practice in conjunction with a change in some beliefs as a result of the professional development program. The most dramatic change occurred with David who evolved from a “structured” teacher to a “flexible” teacher over a period of several months. This shift was underpinned by changes in his beliefs concerning subject matter, the role of students, and student learning. His beliefs about subject matter changed from knowledge that students needed for future schooling to knowledge about issues that are relevant to the students’ local and national context. His beliefs about students
changed from an expectation that students of the same ability should get the same prescriptive knowledge to content that is to "their ability and their standard." This change was reinforced by regularly imagining himself as a student in his own class in an attempt to gain a better understanding of his teaching from their perspective. His beliefs about student learning changed from several styles to many different styles and "ways" that all had their own "different set of complexities." Furthermore, he changed his beliefs about the outcome of student learning from "building a store of information" to a broader interpretation of "knowledge, skills, experiences, memorizing, and feelings." A constraint, however, on his flexible teaching for years 11 and 12 was the prescriptive curriculum because he was still conscious that students need to get to a certain "end point." In his written response to interpretations of data in his case study, he described his change in his understanding of his practice as "fast evolution. The fairly dramatic changes that have occurred are by and large due to this program" (Appendix Q).

Craig's change from a "fun" teacher to an "open learning" teacher was accompanied by a change in his beliefs about student learning and the role of students. He realized from listening to the student tapes that his idea of "fun" was different from his students, and so he changed the way he organized science practicals which was the focus of his teaching. His beliefs about the role of students in conducting practicals changed from following his step-by-step instructions to encouraging them to experiment with their own ideas to achieve a set task. In addition, his beliefs about learning changed from students doing short prescriptive practicals to longer open ended practicals involving more problem solving. This change was accompanied by a shift in his role from directing students during practicals in steps, to negotiating with the students the desired outcome of an investigation and assisting them with their problem solving. A dilemma he experienced with this change, however, was how long to let the students experiment with their ideas and when to intervene to help them. His beliefs about subject matter were reinforced during the program and he "believes even more strongly" that it is more important for students to develop problem solving skills leading to an understanding of concepts rather than learning isolated facts. In his response to interpretations of data in his case study he wrote "The notion of 'fun teaching' is very important to me, however, my idea of practice to
deliver this has varied. . . . the movement towards more open ended practice has been very relevant" (Appendix Q).

Geoff's change from a "reflective" teacher to a "much more reflective" teacher during the professional development program resulted in a deeper understanding of his practice. This was related to a justification of his beliefs concerning student learning, subject matter, and the role of students. At the beginning of the program he believed that it was important for students to become "independent learners." As a result of the program he had become even more aware of this and was encouraging students in "pursuing their own ideas and being responsible for their own learning" (Int. 3. May 1994, TU 45). Consequently, when he plans a unit of work he is more analytical about the students and tries to "think much more critically about what the students really want, like individual students" (Int. 3, May 1993, TU 51). His beliefs about subject matter broadened during the study and he was becoming more aware of the importance of context when organizing learning experiences for students. Although Geoff described himself as a "reflective teacher" at the beginning of the program, he realized at the end that it was necessary to consider "alternative" views on his practice such as in the student tapes to attain a deeper level of reflection, "I was not reflective as I did not examine my practice and look at alternatives—rather, I changed my practice within the constraints of my own experiences and understanding of teaching and learning" (Appendix Q).

The teachers' beliefs about student learning became a major consideration for how they understand their practice. At the beginning of the program, David described himself as a "structured" teacher who organized his teaching based on the factual knowledge that he wanted to give students to prepare them for future schooling. In contrast, as a "flexible" teacher he planned his instruction with a stronger emphasis on his understanding of how students are going to learn. He noted, "the thing that has affected me most is when I'm thinking of what I'm doing, I try to think of how the kids are going to learn and I don't think I ever had that mind-frame before" (Int. 3, May 1994, TU 77) and "collectively . . . they [student tapes] represent ideas or goals that I would like to incorporate into every lesson" (Int. 3, May 1994, TU 381). From his own reflections before the program,
Geoff realized that there were certain conditions, enjoyment and achievement, that influenced student learning and he was trying to address these by giving students more responsibility in their investigations. The professional development program reinforced some of these “gut instincts” but also made him aware of other conditions for learning that provided him with a “knowledge base . . . about how the kids are learning.” Accordingly, when he organizes a unit for teaching, he plans “so that all the sorts of conditions that we’ve talked about through the year are satisfied” (Int. 4, Dec. 1994, TU 5). This knowledge provided him with a “theoretical structure for learning, then it adds up to a real base for your teaching.” Before the program, Craig based his teaching on science practicals that he thought would demonstrate concepts to students. Although Craig did not say that he now based his teaching on his understanding of student learning, he restructured his teaching so that "I've become pushed more towards the self learning and less structure in the content than before" so that students develop problem solving skills and conduct research for half of a topic by choosing electives.

In their group meeting in June 1995, the teachers discussed how their teaching approaches were not static, but varied to suit different classes. This issue was raised by David when he stated that with one group, the top 9/10 class, he had "gone back to being more structured" such as occasionally giving them a worksheet because "they seem to much prefer that type of structure." In agreement, Craig found the same pattern when he taught that class stating that they were not self-directed and "the kids won't do things by themselves." Geoff's reply was that he was happy with this arrangement because the teachers still adapted their instruction to the way that the students best learn. He thought that this was the "biggest impact" of the professional development program for them as a group—that a major consideration for their teaching was how they thought the students would learn:

What you do is you think, and this is where I think the crux is—you now think “How are the kids going to learn?” and you teach the way the kids are going to learn and that is what teachers don’t do. Teachers teach the way they feel comfortable teaching, this is not the way they think the kids learn. And this is where I think, well I know that is where I have changed, that is really the biggest impact. (Geoff, Appendix L)
Research question two: What features of the professional development program influenced change in the teachers' understanding of their practice?

During the study the teachers identified features of the professional development program that enhanced or constrained their understanding of their practice. The enhancing features will be discussed first followed by the features that constrained their understanding of their practice.

Features of the professional development program that enhanced how the teachers understood their practice.

Personal reflection in light of student tapes

The teachers’ personal reflection in conjunction with listening to the student tapes started them changing their understanding of their practice. In describing his model of his own learning in Figure 13, David stated that “as I listened to the tapes on how students learned, I think that really started me thinking and started me sort of summarizing and reflecting in my own mind about a number of different things” (Appendix N). These issues included questions such as: why he teaches the way he does, how he learns, how do students in his class learn, how he plans lessons, his classroom management, what is science, and what should he be teaching? Similarly, Craig stated that the “crux” of the program for him was comparing his ideas about his teaching with what the students said on the tapes as shown in Figure 16 so that “I assessed my thoughts against what the students thought.” Accordingly, he realized that some students’ views were consistent with his own, but others were different. Geoff stated in his description of his model of his own learning shown in Figure 19 that “the thing that starts you off is the combination of listening to the students’ tapes and having the opportunity to reflect on your own performance.” He claimed that this provided a base to start changing his understanding of his practice.

The teachers valued the student data because it was feedback on their teaching from their own students. David described the student anecdotes on the tapes as “evidence” that was “so consistent . . . that you couldn’t refuse it.” In support, Geoff argued that he could not ignore what the students said on tape because it was about his practice describing the data as “right in your face.” He explained that the student data had such an impact because it is so
personal, "It's very difficult for me, I can only speak from personal experience, to ignore something that is so personal. It is your students talking about what they do in your class so I think you have got to take it on board or else, I mean as a teacher you're not worth much" (Int. 3, May 1994, TU 53). Furthermore, because the teachers listened to the tapes intermittently over a period of two years, the tapes gave the program an ongoing focus as stated by Geoff, "I also think the tapes kept it [the professional development program] going because they kept coming back to us and that gave us sort of a focal point to start from" (Appendix L).

The teachers' reflection in light of listening to the student tapes had an impact because the tapes were a knowledge warrant that justified or challenged the teachers' understandings about their practice. Furthermore, the student tapes provided an alternative perspective that influenced the teachers to examine their taken-for-granted assumption that their own students learn science in the same way as they did at school. According to Toulmin (1958), a warrant is evidence that justifies a claim to know something. Furthermore, Scheffler (1965) referred to the term "adequate evidence" to describe data that teachers value and understand that constitutes a knowledge warrant. In this study the student data confronted or confirmed how the teachers understood their practice leading to a deeper understanding of their instruction. In addition, the teachers were seeking new ways to gather student data at the end of the study which suggests that they considered student data as worthwhile views on their practice. For example, David realized when listening to the relationships tape that he needed to be more interactive with his students and from the responsibility tape that he needed to encourage his students to experiment with their ideas, "There is also far more for students to learn other than a content of facts and figures. As you have correctly summarized, this is a reflection of the way I was taught at school and hence being basically the only way I knew, that was the approach that I adopted" (Appendix Q). In contrast, he stated that the trial and error and prior knowledge tapes justified his beliefs and were "good because it reinforced what I already knew but was not practicing." Similarly, Geoff claimed that the responsibility, interest/enjoyment, trial and error, and prior knowledge tapes justified his beliefs that these conditions were important influences on students' learning, "they might not have changed
my views so much as reinforced my views, I already knew that.” Craig stated that the *practicals* and *responsibility* tapes influenced him to change his teaching the most because he realized from them that his idea of having fun by doing practicals, which was based on his own school experiences, and the students’ ideas of fun were different. In particular, he noted that not all the students liked being given prescriptive instructions for practicals and preferred to experiment with their ideas, “The fact that they wanted practicals but what they wanted to do was slightly different than what I’ve been doing, and the fact that they wanted to sort of be more involved in the process of doing the practical rather than being told everything.” Moreover, Craig commented that other tapes justified his beliefs. For example, he suspected that students’ prior understandings enhanced their learning as exemplified on the *prior knowledge* tape and that students disliked copying notes from the board or from books as highlighted on the *writing* tape.

**Central feature of the program**

The central feature of the program for Geoff and David was the group discussions leading to a sense of collegiality that provided encouragement to change. The central feature of the program for Craig was listening to the student tapes as they provided him with insights into student thinking that he previously did not have access to. In describing his model of his own learning (see Appendix N), David stated that there were a number of factors that contributed to his professional development. In Figure 13 he showed how ideas generated from reflecting on his own practice in light of listening to the student tapes encouraged him to participate in the group discussions as “I see the central part of the program as being the discussion and the support of the colleagues, of Craig and Geoff in particular.” Furthermore, David stated that individual change in teaching needed to be accompanied by change at the faculty level in terms of programs and assessment and it was the “support, the ideas, the collegiality as a whole thing” that enabled them to achieve this. Similarly, Geoff stated that this professional development program was different from others because he was encouraged by the collegiality “we feel as though we’re part of a project and part of a process that’s ongoing and not short term” (Appendix N). Craig, however, believed that the “crux” of the program was listening to the student tapes as they enabled him to compare his ideas on teaching with the views of his students. Furthermore, the tapes
provided him with insights that he did not normally have access to because "without the tapes there would be no way of developing an understanding of it [students' thinking] because the students wouldn't come to you with that information." A related feature of the program for Craig was being able to experiment with his ideas and to discuss successes and failures with the other teachers because "if you don't talk to colleagues to try and improve what you're doing, then you'll sit in a hole and never go anywhere." Hence, Craig identified similar features to Geoff and David that influenced change in his understanding of his practice, but placed a different emphasis on them.

**Cyclic relationship of features**

*It was the cyclic relationship among the features of the professional development program that sustained the teachers' changing understanding of their practice.* David stated that listening to student tapes and the collegiality from the group discussions encouraged him to try ideas that led to a cyclic process of change involving ongoing experimentation with his practice, "Then you've got to give those sort of ideas a go, reflect on those ideas, did they work? No, modify it again, did it work? No, okay, chuck it out, forget it. . . and if you can modify it, yes, try it and see what happens and go through the same sort of process of trying it, reflecting on it, evaluating it" (Appendix N). Craig also emphasized that features of the program related as he got ideas from listening to the student tapes, experimented with his practice, discussed ideas with colleagues and returned to experiment with his ideas again in a process with "no end point" because "it's a continually evolving process like a cycle because no group is the same and you have to continually reassess and re-evaluate your successes and failures" (Appendix N). Geoff stated that the professional development program was different from others that he had been involved in because "it is continually reinforced, because it is ongoing and because it has this framework that we keep coming back to." The product of this framework was a "cycle of change" that loops back on itself because of interrelated factors that lead to "change, feedback, more reflection, change, feedback, that cycle all the time bringing in ideas from outside, from other inputs, from your colleagues, from you and so on. And I think if any of these factors had been missing, then it wouldn't have worked" (Appendix N).
Comparison of proposed professional development model with teacher learning models

Features of the professional development program identified by the teachers—personal reflections, student tapes, group discussions, experimenting with their practice, and receiving feedback—were consistent with the three principles of teacher learning and represented in models of their own learning, but not shown in the same configuration as in the proposed professional development model. Towards the end of the study, the teachers held two meetings to see if they could agree on a group model that represented their professional development. The first meeting was held in June 1995, and the teachers produced a draft model (see Appendix L for diagram and meeting transcript). In the second meeting in November 1995, the teachers modified the draft “because it is too complex” (Geoff) (see Appendix M for diagram and meeting transcript). Figure 20 shows the teachers’ final group model and the proposed model that guided the organization of the professional development program originally shown in Figure 9.1 The teachers agreed that it was their personal reflections on their practice in light of listening to the student tapes that started them changing their ideas but "the collegiality then became the crucial focus" (Appendix M). At the end of the meeting, Geoff summarized the features of the group model that they co-constructed referring to the numbers on each “input” (Teachers’ model shown in lower half of Figure 20):

At the top, we've got basically three inputs into the discussion process. We've got one, our interviews; two, student tapes, critical; so they're inputting into discussion and collegiality. Three, we've got the external facilitator/resource base is that right which is Garry. This leads to change and then going back to discussion we have formal and informal feedback . . . and from the change process comes alternative programs, I think assessment can come under practice because it's probably a teaching practice. (see Appendix M)

Consequently, it was not one particular feature in isolation that enhanced the teachers understanding of their practice, but an interaction of several features.

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1 It should be noted that the teachers never saw the sketch of my proposed model shown in Figure 9 and the top section of Figure 20.
Proposed Professional Development Model

Figure 20. Proposed Professional Development Model (top) and Teachers' Group Model (lower)
As previously discussed, the teachers, individually and collectively, conceptualized models of their own learning as a result of the professional development program. This suggests that the program contributed in a substantial way to how the teachers changed their understanding of their practice. Although not in the same configuration, there are similarities between the teachers' models of their learning and the proposed professional development model. All three teachers indicated that what started them changing their understanding of their practice was their personal reflection in light of listening to the student tapes. In addition, all the teachers represented this notion of comparing their ideas on their practice with the students' ideas at the top of their models shown in Figures 13, 16, and 19. This notion is consistent with the center of the proposed professional development model in Figure 9 (and top of Figure 20) showing interplay between the two principles of teacher learning. In this respect, teachers reflect on their experiences to gain a better awareness of their beliefs and consider alternative perspectives in the form of students' views on their learning experiences recorded on the tapes. Furthermore, this was an ongoing feature of the program, as the teachers listened to the 16 tapes of collated student interview comments describing influences on their positive and negative learning experiences over a period of two years until the end of 1995.

This ongoing process of personal reflection in light of the views of students was encouraged by the collegiality among the group with a common purpose to change their teaching. Both David and Geoff claimed that the central part of the program were the ongoing group discussions and the collegiality among the group that encouraged them to sustain their learning. Although this was not the "crux" of the program for Craig, he did say that the group discussions were an important part of the process that would not work without it. Furthermore, two other features that all three teachers identified involved the notion of experimenting with their practice and receiving feedback from either me, students, or colleagues. All three teachers highlighted the notion of experimenting with their ideas in their individual models, and Geoff also highlighted the notion of feedback in his own model. Although David and Craig did not include feedback in their individual models, it was a feature highlighted in their interviews. These features—collegiality, group discussions, experimentation, and feedback—are consistent
with the third principle of teacher learning, community learning environment, that underpinned the proposed professional development model. In particular, the conditions for learning in Figure 9—responsibility, practice, approximation, and feedback—are consistent with the features of experimentation and feedback.

There are, however, several differences in the teachers' models and the proposed professional development model. First, the teachers did not identify specific conditions for learning as part of their models. This is not surprising considering the abstract nature of these conditions. Although the teachers highlighted the importance of experimentation and feedback, they never mentioned the other conditions of immersion, engagement, expectation, and demonstration. A second major difference in the models is that in their group model, the teachers included "change" leading to "alternative programs" and "alternative practice." This was an outcome of their learning, but was not included in the proposed model as I was uncertain what the outcomes of the program would be. Furthermore, the teachers identified the importance of "time" for discussion in their model which is not explicit in the proposed model but implicit in the condition of immersion.

In summary, although the teachers' models of their own learning and the proposed model are not in the same configuration, there are similarities. In particular, the teachers identified features of the program that are consistent with the three principles of teacher learning in the proposed model. For instance, the feature of reflection in their personal models and "interviews" in Figure 20 are consistent with the principle of awareness; the features of "inputs" from "student tapes", "discussion", and "external facilitator" are consistent with the principle of alternatives; and the features of "collegiality", experimenting with ideas in the form of "change" and "feedback" are consistent with the principle of a community learning

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2 The teachers did not highlight their personal reflection in the group model because the model represents what they did as a group. Hence reflection to these teachers is a personal process and was a key feature of their individual models. The interviews, however, focused on their understanding of their practice generated from their personal reflections.
Furthermore, the teachers identified that these nominated features did not act in isolation. They all contended that it was the connections between the features that supported change as they kept linking to other features which they described as "cycles" of change. This is represented by the spider web that connects the principles in the proposed model, although there was no effort on behalf of the teachers to show all the connections between the features in their models. What is pertinent, however, is that the teachers acknowledged the importance of the relationship between the features of the program that enhanced their understanding of their practice and that their learning was non linear (see Appendix L and M).

Features of the professional development program that constrained how the teachers understood their practice.

The three teachers agreed that their reflective journals did not enhance their understanding of their practice. The original purpose of the journals was to assist teachers with their reflection on their practice and to enable them to document any changes. Although they did use the journals for the first few months of the program, they ceased using it after this time. Both Craig and David mentioned that they could not see the point of it and it was a low priority on their list of daily duties.

A lack of time for discussion constrained the teachers developing a better understanding of their practice. The teachers claimed that the program generated a good deal of work as all science programs for years 7-10 were re-written as well as several policies. Furthermore, with the busy routines of secondary school teaching, the teachers needed more time to share their ideas with their colleagues. They thought that the three professional development days during the two and a half years were invaluable in terms of providing time for sustained discussion that developed a trust which is necessary for such a community. Furthermore, the follow up meetings and informal discussions that resulted from these days were useful, but they needed to be more regular. In 1996, the teachers are intending to have fortnightly meetings to provide more continuity in their discussions.
II. Conclusions Regarding the Purpose of the Study

Findings from the study discussed in part I suggest that there was a substantial change in how the teachers understood their practice as a result of the professional development program. Furthermore, features of the program that the teachers identified as enhancing their understanding of their practice—personal reflections, the student tapes, group discussions, experimenting with their practice, and feedback on their ideas—were consistent with the principles of teacher learning in the proposed professional development model. These findings are now discussed in relation to the purpose of the study which was to explore the value of the professional development model and to identify issues to be considered when using the model in a secondary school setting. As a result of the study, two strengths of the professional development model were evident; and three issues were identified that need to be considered when using the model in another setting.

Strengths of the professional development model
(a) Organizational framework for sustained knowledge-building

This professional development model is similar to other inside/outside professional development models in which participants conduct research and share their ideas as a community to gain a better understanding of their practice (Cochran-Smith & Lytle, 1993). In this respect the model focuses on teachers reflecting and discussing ideas from their “inside” perspective in light of ideas from “outside” perspectives. There are, however, two differences that distinguish this model from other studies of “inside/outside” professional development models.

First, other studies have used a variety of sources to provide teachers with alternative perspectives on their practice, but have not explored the use of student interview comments identifying influences on their positive and negative experiences. For example, other studies have used alternative perspectives from educational research (Bell, 1993; Richardson, 1994), the views of teachers, teacher educators and student-teachers (Cochran-Smith & Lytle, 1993; Darling-Hammond, 1994; Grossman, 1994), and the views of teacher educators working in collaboration with teachers (Baird & Mitchell,
1986; Mitchell & Erickson, 1995). Although students’ views on their learning are often outside the regular teacher discourse, it an alternative perspective that is contextual to how the teachers understand their practice.

Second, other studies have identified “conditions” and “components” for staff development, but have not analyzed the interactions between them. For instance, Placier and Hamiliton (1994) mentioned four conditions under which staff development is likely to occur: (a) positive working conditions, (b) teacher autonomy, (c) motivation and freedom to change, and (d) a community of practice, but did not discuss how these components influence each other. On the other hand, Bell and Gilbert (1993) highlighted the interdependence of three components for teacher development—professional, personal and social development—stating that teachers need input of new theoretical ideas from research and time to practice with support and feedback. Their study, however, did not explore the relationship between these components to illuminate the process of how teachers construct knowledge.

Fenstermacher (1994) recently argued that teacher beliefs need to be submitted to a process of justification to constitute knowledge. The three interrelated principles of teacher learning that underpinned the proposed professional development model shown in Figure 9 support the process of teachers justifying their beliefs to practical knowledge in three ways. First, teachers develop an awareness of their beliefs as they reflect on their practice. For example, the teachers claimed that their initial reflections on the question of “Why do you teach the way you do?” for a month followed by their individual interviews assisted them to better understand their practice as they had to provide reasons for their instruction. This is consistent with Fenstermacher’s notion that providing reasons for actions is the “minimum form of warrant for practical action” (1994, p. 45). Second, the teachers identified the group discussions as the central feature of the professional development program with inputs from several alternative perspectives: (a) the student tapes, (b) other teachers, and (c) my own input. This interchange of ideas back and forth between the teachers in light of evidence from the student tapes is a process of justifying personal beliefs about their practice. In particular, the student tapes justified or challenged the teachers’ beliefs and so
constitute a knowledge warrant for how teachers understand their practice. Third, consistent with the principle of a community learning, environment, the teachers experimented with their practice to see what "worked" or "did not work" based on feedback from students and colleagues. This is, from a pragmatic perspective, another procedure for justification, as the teachers explored the consequences of their ideas by trying them out, evaluating them, and discussing their successes and failures in subsequent meetings (Cherryholmes, 1989).

This process of teachers clarifying their beliefs though personal reflection, and then being involved in several procedures to justify their beliefs resulted in the teachers building practical knowledge that is relevant to their context. Furthermore, this process of knowledge-building continued for two and a half years because of the way that the principles of teacher learning in the proposed professional development model interrelate. This was exemplified by the way the teachers explained their models of learning and emphasized how the features of the professional development program interconnected. For example, David referred to the process of reflection, discussion and trying ideas as returning to "the same sort of process," Craig referred to it as a "cycle with no end point" and Geoff referred to it as a "cycle of change." The effect of this cycle is that the teachers were engaged in an iterative process of clarifying and justifying their beliefs leading to a deeper understanding of their practice. Hence, it was the ongoing interactions encouraged by the group discussions in light of listening to the student tapes over a period of two years that produced a "knowledge base, I guess a research base to enact change" (Geoff, Appendix N). In summary, a strength of the professional development model is that it provides an organizational framework to support teachers in sustained knowledge-building within their community.

This notion of teachers reflecting and sharing their ideas in light of evidence from their own students is consistent with Bereiter and Scardamalia's (1993) term of a "knowledge-building community" which is "a method of social organization that allows both individual and group expertise . . . that leads to collective advances in knowledge" (p. 200). Although they use the term in reference to a classroom community for
students, the group of teachers displayed characteristics of a knowledge-building community:

(a) The teachers were involved in an inquiry over a long period of time to gain a better understanding of their practice. Although the study was initially intended to run for 12 months, it continued for two and a half years and Geoff suggested that this program is a four year project, “one year to start reflection . . . two years to try out ideas and also to incorporate that into your programming, and then a fourth year to consolidate what you are doing.” (Appendix N)

(b) The knowledge-building discourse was self-sustaining as it was driven by the teachers’ discussions and questions about their own practice along with the student tapes as evidence that they valued and understood.

(c) The teachers sometimes decided on collective paths of action such as producing a writing policy (Appendix R), new science programs for years 7-10 based on outcomes (Appendix S), and an assessment policy (Appendix T). Furthermore, in September 1995, the school underwent a “Quality Assessment Review” and the science department listed 11 initiatives for the review that were related to the professional development program (see Appendix U).

(d) There was a range of experience among the community members providing a variety of ideas about classroom practice.

(e) The teachers were involved in research as they experimented with their practice and exchanged ideas about what did and did not work. In this respect the group of teachers was similar to a small research team with Geoff being the leader and a role model as a reflective teacher.

3 This is an external school review team sponsored by the New South Wales Department of School Education that inspects each school in the state every two years.
A second strength of the professional development model is that it is underpinned by a theoretical basis for teacher learning relating individual and social influences on knowledge construction. Each teacher in the professional development program identified that their personal reflections assisted them to better understand their practice as exemplified in interviews at the beginning of the study. Also, this aspect was highlighted in the teachers' individual models of their own learning shown in Figures 13, 16, and 19. This is consistent with Schön's (1983, 1988) notion of "the reflective practitioner" suggesting that teachers need to regularly reflect on their own practice as a context for generating knowledge. This view of learning is underpinned by a constructivist perspective suggesting that an individual's prior understandings about their practice influences their meaning making. Although most of the literature concerning a constructivist perspective refers to children's learning (Osborne & Freyberg, 1985; Cobb, 1994; Driver et al, 1994), this perspective is becoming prevalent for teacher learning (Bell, 1993; Darling-Hammond, 1994; Mitchell & Erickson, 1995; Richardson, 1994).

In the professional development model, this individual influence on learning was supported by social influences in the form of alternative perspectives. In short, teachers justified their beliefs to knowledge by comparing their understandings about their practice with other views from teachers, their students, and myself. In his response to his case study, Geoff stated that before the study he was not as reflective as he originally thought and changed his teaching "within the constraints of my own experiences and understanding of teaching and learning" (Appendix Q). However, because of the perspective introduced via the student tapes his "knowledge and understanding have expanded considerably and my practice has improved." Similar opinions were expressed by David and Craig stating that it was the student tapes that provided them with a view on their practice that they or others in the group could not have contributed. In short, the professional development model encouraged teachers to become aware of their beliefs by reflecting on their practice and then to compare their ideas with others by interacting with their colleagues and myself and listening to their student' views via the tapes. This interplay between individual and social influences resulting in knowledge construction is consistent with a social constructivist
perspective on learning (Bredo, 1994; Cobb, 1994; Driver, Asoko, Leach, Mortimer, & Scott, 1994; Garrison, 1995; Prawat, 1995; Prawat & Floden, 1994).

This theoretical basis for teacher learning in the model, involving the interaction between individual and social influences on learning, is also consistent with Dewey's theory of learning through experience (1897, 1901, 1916, 1938). He argued that learning through personal experience involved "social factors that operate in the constitution of individual experience" (1938, p. 21). This learning depended on the interplay between two principles—continuity and interaction. In his principle of continuity, Dewey (1938) suggested that "the experience learners already have . . . provides the starting point for all further learning" (p. 74) which is enhanced by reflection (Dewey, 1933). Similarly, the professional development program started with the teachers' experiences by asking them to reflect upon the question "Why do you teach the way you do?" for a month followed by two interviews to discuss how they understood their practice. Moreover, Dewey (1938) claimed that growth in experience occurs through social processes based on his principle of interaction, "the principle that development of experience comes about through interaction means that education is a social process. This quality is realized in the degree in which individuals form a community group" (p. 58), and it is the role of a teacher to engage students in community activities by providing "subject matter" in context with their experiences. Similarly, in the professional development model the student tapes provided contextual data and this was shared among a community of practitioners.

According to Dewey (1938), it is the responsibility of the teacher to encourage classroom interactions and to "arrange conditions that are conducive to community activity" (p. 58). In this respect, a setting that exemplified a community for Dewey was young children learning in an "intelligent" family with interaction being fostered by these conditions: engagement, responsibility, participation, expectation, approvals, demands, condemnation, and demonstration (Dewey, 1901, 1916). Dewey's conditions are very similar to the conditions for learning used in the proposed professional development model to encourage teachers to experiment with their practice and receive feedback resulting in the sharing of ideas within a community learning environment (Cambourne, 1972, 1988). In support,
Huberman (1995) recently noted that the kind of problem solving in communities of teacher researchers involving learning by “experimentation and change” (p. 217) are the same conditions of learning for adults or children. Interestingly, this notion of teachers experimenting with their ideas was an argument that Dewey (1904) proposed for preservice teachers to relate theory and practice as “only ‘practice’ can give a motive to a professional learning, and supply material for educational courses” (p. 16).

In summary, the main strengths of the professional development model are that it provides an organizational framework to support teachers in sustained knowledge-building within their community, and the model is underpinned by a theoretical basis for learning relating individual and social influences on knowledge construction. Hence, the model is consistent with a social constructivist perspective on learning (Bredo, 1994; Cobb, 1994; Driver, Asoko, Leach, Mortimer, & Scott, 1994; Garrison, 1995; Prawat, 1995; Prawat & Floden, 1994) and Dewey’s theory of learning through experience (1897, 1901, 1916, 1938). In addition, the substantial change in how the teachers understood their practice in this study provides evidence to support both the perspective and the theory. This consistency between the theoretical basis of the proposed professional development model and both a social constructivist perspective and Dewey’s (1938) theory of learning through experience support analytical generalizability of the model (Firestone, 1993; Yin, 1989). However, there are three issues—ethics, collegiality, and uncertainty—to be considered when using the model that possibly restrict its scope or generalizability for use in other settings.

**Issues to consider when using the model**

(a) Ethics

It was clear from the study that the use of student data as an alternative perspective was a powerful vehicle for teacher learning as the data are contextual to the teachers’ understanding of their practice. There are, however, ethical concerns regarding students disclosing information about the classroom practices of their teachers. Also, the students’ views are personal and can be confronting for teachers. For example, there was not unanimous support to participate in this program at the first school I approached because two out of the five teachers on the science staff were
unwilling for me to interview their students. Furthermore, there are concerns about maintaining confidentiality for the students. In the initial student interviews in this study, participation was voluntary and I told the students that their comments would be collated onto theme tapes so they would remain anonymous. This was not the case, as it became a point of discussion in the meetings to identify the voices when we listened to the tapes. This raises the possibility that there could be negative consequences for a student if a teacher could identify the source of a particular comment they did not appreciate. In this study, however, the teachers thought that it was an advantage to be able to identify students, as they were able to adapt their teaching to the particular needs of individual students. For example, some students who did not like doing science practicals and preferred to conduct library research were given options to suit their preferences in later classes.

There are, however, ways to manage this issue to increase the likelihood that the students' identity is protected. For instance, the teachers could be provided with collated anonymous transcripts of the interviews which would eliminate the need for audio recordings. Alternatively, if the tapes were deemed necessary, the transcripts could be read by other students so that the voices were not readily identifiable. Finally, it would be appropriate to allow the students to listen to the final version of the student tapes with the aggregated anecdotes. This would enable them to scrutinize the final product of collated student data to be presented to the teachers. Also, I think it would be worthwhile to provide teachers with an option as to whether they would like to hear comments from the students regarding influences on their positive as well as their negative learning experiences. Nonetheless, as students are still talking about classroom experiences that are contextual for the teachers, it is impossible to guarantee anonymity of the students.

(b) Collegiality

A second issue concerning use of the professional development model is that opportunities for sustained learning are limited by the extent to which the teachers are prepared to share their ideas as a community. In the study the teachers identified that their discussions not only provided a source of ideas, but provided mutual support to change their practice. Although it is
difficult to encourage teachers to be collegial and share their experiences (Clarke, 1996; Hargreaves, 1994, 1993; Huberman, 1993), I believe that addressing the conditions for learning may provide a guide to make this desirable situation possible. For instance, I contend that teachers are more likely to share their ideas if they are willing to participate in this type of professional development program and see benefits to them (engagement); they are encouraged to be autonomous and experiment with their ideas by their administrators (responsibility, practice, and approximation); there is designated time for teachers to reflect and discuss their practice (immersion); and there are role models of reflective practitioners already within the school (demonstration). During the study I discussed this matter several times with Geoff who suggested that this model would work as long as a majority of teachers were willing to participate. He believed that the program would create a momentum of its own that may lead to other teachers participating at a later date if they could see benefits to the practice of other teachers.

(c) Uncertainty

The third issue regarding use of the model is that it does not provide a prescriptive curriculum for teacher development, as progress is determined by the interests, data collected, and initiatives of the participating teachers. This may be an issue for school administrators, as it is impossible to predict which aspect/s of their practice the teachers may want to address as a result of reflecting and listening to the student tapes, or whether this would occur at all. Furthermore, some teachers may not value student data as an alternative perspective on their practice. If this were the case perhaps other sources of data such as educational literature may be valued by the teachers. Accordingly, it would be worth exploring this issue with the participants to ascertain what forms of evidence they would value as an alternative perspective on their practice during the early negotiations.

III. Implications of the Study for Practice

All professional development programs provide opportunities for teacher learning. What is debatable, however, is the quality of learning possible in view of the limitations of some programs. As a result of this study I would define quality teacher learning as sustained knowledge-building resulting in a
deep level of understanding of one's practice. The three interrelated principles of teacher learning that underpinned the proposed professional development model increase the likelihood of teachers engaging in sustained knowledge-building. For this process to occur, teachers need to reflect on their practice to clarify their beliefs (awareness), consider alternative views from students and/or colleagues/teacher educators to justify their beliefs (alternatives), and experiment with their practice whilst receiving feedback with the support of a collegial group (community learning environment). In short, it was the dynamic interplay between these three principles for teacher learning that had a substantial influence on how the teachers understood their practice and sustained the professional development program for two and a half years.

An indicator of the quality of teacher learning promoted by the proposed professional development model was the extent of change in the teachers' understanding of their practice as discussed in section I of this chapter. In particular, there was not only a substantial change in how the teachers described their practice, but there was also a change in the emphasis of the beliefs that supported their understanding of their practice. It was evident from the study that as the teachers became more informed about student learning that there were also changes in their beliefs concerning students and subject matter. All three teachers highlighted during the study that when they considered how they were going to teach a topic, a major consideration in their thinking was how the students were going to learn. This understanding also influenced their purpose for teaching subject matter. For example, Geoff realized the importance of context for subject matter and David changed dramatically to place more emphasis on the social issues more relevant to the students' experiences. This is consistent with Dewey's (1990/1902) notion of psychologizing the subject matter which gives "the subject-matter some psychological meaning" (p. 205). A flow on effect was that deeper insights into student learning provided by the student tapes resulted in changes on a broader scale such as the organization of new programs (see Appendix S) and policies (see Appendix R, T, and U) which are represented as "alternative programs" and "alternative practice (assessment)" in Figure 20.
The way that other professional development models are organized, however, often restrict opportunities to encourage this level of quality teacher learning. Many professional development models are consistent with one or two principles of teacher learning, but rarely do they interrelate all three of the principles that I have described for sustained knowledge-building. For instance, the organization of "inside-in" models encourages teachers to learn about their practice by reflecting and experimenting with their own ideas. This notion of investigating and reflecting on one's practice assists teachers to clarify their beliefs which is consistent with the principle of awareness. Furthermore, teacher researchers often collaborate in their investigations and discussions similar to the principle of a community learning environment. Their understandings generated from their reflections, however, are often underpinned by taken-for-granted assumptions that frame how the teachers interpret their practice. Accordingly, in many cases these programs often neglect the principle of alternatives to provide teachers with different perspectives on their practice to consider ideas that are beyond their experiences. Furthermore, although inside-in models often involve groups of teachers sharing ideas on their practice, it is questionable how "alternative" views are from teachers with similar perspectives on teaching and learning.

In contrast, "outside-in" models emphasize knowledge that others generate for teachers for the purpose of exposing teachers to new ideas to extend their existing understanding of their practice. This notion is similar to the principle of providing alternative perspectives. But often the organization of these programs fail to consider the principle of awareness to encourage teachers to reflect on their practice that provides a context for considering new ideas or incorporate a community learning environment to support ongoing teacher discussions and change. The result is that in emphasizing one principle and not considering other interrelated principles, both "outside-in" and "inside-in" professional development models present limited opportunities for sustained knowledge-building. Consequently, the main implication of this study is that organizers of professional development programs should not only consider each principle of teacher learning, but the interrelationship between them to provide teachers with opportunities for sustained knowledge-building.
IV. Further Research

This study creates possibilities for further research in two areas: (a) returning to the same school to extend the present study, and (b) to explore some of the ideas presented in this study in other contexts.

(a) Further research at the same site

As the teachers have continued the professional development program into 1996, it would be worthwhile to spend time in their classrooms in an attempt to observe the relationship between their understanding of their practice and their classroom instruction. Also, it would be important to ascertain if the teachers' change in their understanding of their practice documented in this study is beneficial for student learning. This would address two limitations of this study. Furthermore, there are two priority issues that the teachers have targeted for investigation in 1996.

The first issue regards exploring some way to maintain a supply of data on student learning to inform their practice. During the study, the 16 student tapes were used in teacher meetings over a period of two years. In this respect the teachers often would start a meeting by listening to one of the tapes which not only provided an alternative perspective on their practice, but a purpose for the meeting as well. At a group meeting towards the end of 1995, however, the teachers raised the issue that the student tapes had just about reached their "shelf-life." The reason was that their teaching had changed so much in two years that comments on the student tapes had little relevance to their current practice. In particular, David stated that he wanted more "fresh" data from his students "to keep his thinking going." At the end of 1995 the teachers decided that they would explore the possible use of students using diaries in addition to their regular science workbook for two reasons. First, the teachers are giving their students the science program at the beginning of each topic so that the students can monitor whether they are achieving the intended outcomes as they progress through it. The second purpose of the diaries is for students to document what teaching strategies "worked" or "did not work" during the week. The goal is that the teachers will have discussions with students about their learning and hopefully have access to ongoing student feedback concerning what they are teaching, and how they
are teaching. At this stage all students from years 7-10 are using workbooks and student diaries in science. In addition, the teachers are providing time at the end of each lesson to encourage the students to record their reflections. The first full day meeting of the teachers is in June 1996 to discuss ways to assist students to become more metacognitive so that they can monitor and document their learning more easily.

The second priority for 1996 is to improve their assessment policy shown in Appendix T. A difficulty that the teachers realized as they progressed through the professional development program was that their assessment procedures did not match their change in teaching. In some cases, they were still using conventional assessment procedures, which mainly tested students' factual knowledge, rather than their depth of understanding of a science concept. Also, as the teachers began to create a more flexible curriculum for the students, it became problematic to assess them using common written tests or tasks. Consequently, they agreed that they need to explore alternative assessment procedures which are more suitable to their current ways of teaching.

(b) Further research in other contexts

This study involved three committed teachers who were friends at the outset with a head of department as a role model who was already experimenting his practice before the program started. Hence, it would be appropriate to explore this model in another setting with a different group of teachers to ascertain if it supports their learning to the same extent as in this study. In this respect it would be worthwhile exploring the use of this model with a group of teachers from a different subject area. Also, interviews with different groups of students may illuminate other factors that influence their learning salient to their context such as cultural conditions. Furthermore, aspects of this professional development model may have an application to existing school/university communities. For example, there are many groups of teachers, teacher educators, and sometimes student-teachers who regularly collaborate as a community (Baird & Northfield, 1992; Cochran-Smith & Lytle, 1993; Darling-Hammond, 1994; Grossman, 1994; Mitchell & Erickson, 1995). Perhaps these groups would welcome the additional input of their students based on similar student interviews conducted in this study.
This could focus on students commenting on learning in different subjects and then data could be collated into various subject areas depending on the interests of the teachers. Of course this could only occur with proper ethical approval including permission from the participants involved. In addition, perhaps this model has application for tertiary education using interview comments from current students or beginning teachers to provide teacher educators with an alternative perspective on their practice in a long term professional development program.

A more difficult issue, however, is whether this professional development model has any application for schools in which teachers do not collaborate as a community. As a staff developer, I believe that I can work with teachers to manage the principles of awareness and alternatives in most school settings. What is more problematic, and previously highlighted as one of the main issues when using the model, is incorporating the other vital principle of a community learning environment. Although I suggested in the previous section that the conditions for learning in a community (Cambourne, 1988) provide a useful guide, these are not a recipe for collegiality. The question at the heart of this issue is what can be done to encourage teachers to share their ideas as a community? The potential is there. What matters most to teachers is “the character of the workplace as a professional community” (McLaughlin, 1993, p. 100). But often there is no infrastructure to foster this in secondary schools. The teachers in this study highlighted the need and value of having time to share their ideas and develop a level of trust. I wonder what would happen if school timetables could be organized to provide teachers with a regular meeting time, not to talk about school policies or new curriculums, but to share what they already do in their classrooms? Perhaps this may begin to address Sarason’s concern:

Whatever factors, variables, and ambience are conducive for the growth, development, and self-regard of a school’s staff are precisely those that are crucial to obtaining the same consequences for students in a classroom. To focus on the latter and ignore or gloss over the former is an invitation to disillusionment. (Sarason, 1990, p. 154, emphasis in original)
REFERENCES


Huberman, M. (1993). The model of the independent artisan in teachers’ professional relations. In J. Little & M. W. McLaughlin (Eds.), Teachers’ work: Individuals, colleagues and contexts (pp. 11-50). New York: Teachers College Press.


APPENDICES
Appendix A-Electronic Mail from Brian Cambourne

Brian Cambourne, 10/23/95 10:32 AM, ququisition og

Date: 23 Oct 1995 20:32:49 +1000
From: "Brian Cambourne" <Brian_Cambourne@uow.edu.au>
Subject: ququisition og
To: "Garry Hoban" <gfhoban@unixg.ubc.ca>

Garry, Sorry to take so long to reply o you. I've been away in Melbourne training the frameworks program and the phone system was archaic and I couldn't tap into the email system.
I have no problem with your decision to change the descriptor from natural to community learning. Nor do i have any hangups about conditions "for" rather than "Of" learning. I think it's a more accurate description.
I didn't do a longitudinal study. It took me three years of work, one of which was field work. It's a snapshot study of children's language in different settings. The underlying language theory was Chomskyan in flavour and the research model was based on Roger Barker's "ecological psychology" theory which was one of the first attempts by psychologists to map the distribution of phenomena in experimenter free settings.
The Reading Teacher article is Vol 49 no 5 Nov 1995.
I liked your comprehensive paper. The only bit I had any trouble with was the statement that implied that language acquisition was basically a process of learning names of objects. This a a very simplistic, almost a behaviourist view of language. My study was more about the acquisition of the control of grammar in particular the development of control of sentence combining transformations.
Hope this finds you well and healthy.
Did you know that I'm still getting credit for being your supervisor. Did you ever formally withdraw fro U of W ?

BC

To: Brian Cambourne
From: Garry Hoban on Thu, 19 Oct 1995 3:14 AM
Subject: Re: Some Good news

RFC Header:
Received: by uow.edu.au with SMTP; 19 Oct 1995 03:13:18 +1000
Received: from unixg.ubc.ca (mail.unixg.ubc.ca [137.82.27.14]) by wyrm.cc.uow.edu.au (8.6.10/8.6.11) with ESMTP id DAA25252 for <Brian_Cambourne@uow.edu.au>; Thu, 19 Oct 1995 03:13:02 +1000
Received: from [137.82.233.184] (n756.net.ubc.ca [137.82.233.184]) by unixg.ubc.ca (8.6.12/8.6.12) with SMTP id KAA17834 for <Brian_Cambourne@uow.edu.au>; Wed, 18 Oct 1995 10:12:51 -0700
Date: Wed, 18 Oct 1995 10:12:51 -0700
X-Sender: gfhoban@pop.unixg.ubc.ca
Message-Id: <v01530501aca8187e90c@[137.82.233.184]>
Mime-Version: 1.0
Content-Type: text/plain; charset="us-ascii"
To: "Brian Cambourne" <Brian_Cambourne@uow.edu.au>
From: gfhoban@unixg.ubc.ca (Garry Hoban)
Subject: Re: Some Good news

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At the moment I am writing chapter 4 of my 8 chapter thesis. All seems to be going well and I am trying to get as much done before we fly home on the 31st December.

I do need to check a few things with you. The way I am describing the professional development model that I have explored is that "it encourages teachers to reflect and share their experiences in light of their students’ interview comments supported by a learning environment based on conditions for learning in a community". The conditions of course are your conditions and duly named but I have changed the way I am using them from "natural learning" to "conditions for learning in a community". This fits my study much better and allows me to draw parallels with John Dewey’s conditions which were also derived from children learning to talk. Do you have any problems with this?

Also I have included details that you sent me in terms of how you derived the conditions. I know you tracked children in 24 families but how many children and was this a longitudinal study tracking the same children learning to talk over three years? Thanks for your help. I just want to get the details right.

Cheers
Gaz
PS Is your Reading Teacher paper in November this year?
Appendix B-Interactive Learning Environment Overview

Interactive Learning Environment (ILE)
(September, 1992)

* Research during the last 10 years states that students learn science best of all when they are investigating their own ideas within a community.

### Cambourne's Conditions of Learning in a Science Context

<table>
<thead>
<tr>
<th>Condition</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Engagement</td>
<td>Students see a purpose for activity</td>
<td>Students are given tasks that they can identify with.</td>
</tr>
<tr>
<td>2. Immersion</td>
<td>Students surrounded by science (lab)</td>
<td>Students have examples of science reports displayed around the classroom. Students have access to equipment in laboratory. Students are focused on this work over a period of time.</td>
</tr>
<tr>
<td>3. Demonstration</td>
<td>Teacher models to students what to do</td>
<td>Teacher models informal and informal writing. Teacher models process of investigation</td>
</tr>
<tr>
<td>4. Expectation</td>
<td>Teacher makes clear what he/she wants students to do</td>
<td>Students are expected to write their own drafts and reports including conducting investigation.</td>
</tr>
<tr>
<td>5. Responsibility</td>
<td>Students given responsibility Students make their own decisions about how to investigate the problem.</td>
<td>Students given freedom to use anything in the lab for their investigation. Teacher may have to remove dangerous or expensive equipment from laboratory. Students responsible for their own recording of events. Students are given a problem to address without a method (e.g. make an electrical circuit or investigate a particular creek)</td>
</tr>
<tr>
<td>6. Approximation</td>
<td>Students can try their ideas several times without fear of “getting it wrong”.</td>
<td>Students encouraged to try their own ideas Students encouraged to write about their own ideas including errors using guide questions.</td>
</tr>
<tr>
<td>7. Practice</td>
<td>Investigation by trial and error</td>
<td>Students given opportunity to try this approach.</td>
</tr>
<tr>
<td>8. Feedback</td>
<td>opportunity to try ideas, negotiation and discussion with teacher</td>
<td>Teacher acts as facilitator rather than director. Teacher/ student discussion ongoing. Teacher respond to the students' ideas. The focus is to help them not to fall into “dead-ends”. So the teacher can give pointers where appropriate in an advisory role.</td>
</tr>
</tbody>
</table>
Guideline for Teaching and Writing

The teacher should keep in mind that a science experiment should be a process of learning and writing:

- Find out students' ideas
- Students test their own ideas
- Students modify investigation and understanding

Students should write informally and above all be encouraged to write about their own ideas rather than the teacher's expected outcome. Students should use the first person "I" and not be concerned with scientific jargon. This could be attempted in three phases:

**Phase 1**
These three questions could be used as a guide in a one-shot practical. (students could write this for homework like a story or narrative about their science experience)

1. What did you do?
2. What happened?
3. What did you find out and why do you think it happen?

**Phase 2**
For on-going experiments where the students get to test their own ideas a fourth question could be added:
4. How can you test what you think?

It will take practice but the students need to be encouraged to write about their own ideas. If necessary, the teacher may occasionally move onto the third phase:

**Phase 3**
Write a formal science report to summarise your findings so that it can be understood by another scientist. This should be written using a formal report genre: Aim, method, result, conclusion.
Appendix C-Conditions for a Naturalistic Learning Environment

Diagram showing the conditions for a naturalistic learning environment:

- Teaching Context
  - Teacher's View of Learning
  - Pedagogy
  - Curriculum
  - Assessment & Evaluation
  - Resources

- Engagement
  - Prior Knowledge
  - View of Learning
  - Motivation
  - Social Factors
  - Preferred Learning Style
  - Developmental Factors

- Learning Task
  - Meaningful
  - Problem Solving
  - Active
  - Purpose

- Reflection

- Immersion

- Responsibility

- Approximation

- Practice

- Modelling

- Collaboration

- Feedback

- Expectation
Appendix D-Teachers' Evaluation of Inservice

Evaluation Of Garry Hoban's Inservice

This evaluation is in the form of a series of comments made by Michael Croucher and others received from Denise Franks, Carolyn Murphy and Wendy McIntosh who attended the inservice course.

* It was old research - a lot of it had been heard before and was therefore already in use.

* The use of butcher's paper which was adhered very poorly to the wall was messy and made the information difficult to read. It would be better to ensure that the course was held in a more suitable room with a large whiteboard or other such equipment.

* The video was very good - the students said things that they normally would not say to us as teachers. They were not afraid to give their 'real' opinion and were open and honest. It was extremely valuable to hear the students point of view and then use that to think about our teaching methods and style.

* As a Presenter Garry has a pleasant manner, is non-threatening and is also easy to talk to.

* Garry only wrote down (onto the butcher's paper) what he wanted to hear and also altered what we had said to suit his line of thinking.

* Garry didn't convey what he was trying to do very well to us - the point of the course was not really that clear.

* He tried to put words into our mouths and misinterpreted the meaning of what we were trying to say.

* I can't really remember what it was all about (hence it did not leave much of an impression). It was not clear what he was asking at times. e.g. the characteristics of a successful experience and of a failure - what was the point?, why could it not be a school experience? etc - more explanation should be given about this task.
The features and conditions of learning that were discussed were just a review of what we already knew - however it seemed that they were being presented as something new and brilliant.

It was worthwhile to get us to think of the features of a good lesson that we had taught and then discuss it - it made me look at my own teaching methods and gave me some ideas from other people.

The handout on "Learning In School and Out" by Lauren P Resnick was valuable reading which gave a lot of information.

"Conditions of Learning" adapted from Lambourne were also of interest - though they would have been better if we did more on how to apply them to our classroom situations and if more information was given on how we could use them to help our students.

Garry pushed the idea of "meaningful learning" quite strongly but he didn't really help us with ways we can achieve it with our students.

Finally we would all like to say thank you for coming out and doing the course with us and which you all the best in taking a revised version to other schools.
Appendix E-Coordinator's Evaluation of Inservice

Gary Hoban presented an inservice package based on conditions of learning for an effective classroom over three afternoons after school. From my perspective, both positive and negative outcomes were observable. These are elaborated upon below in a series of not necessarily linked comments.

The timing of the inservice sessions could have been given greater consideration as it fell just before and during an exam period for the Senior school. This had the effect of causing some resentment among staff who felt that their time could have been more productively spent on preparation/marking. This problem was exacerbated by having several people within the Science staff holding other positions of responsibility in the school, thus making their available time even more scarce. As well, it must also be considered that the majority of teachers generally have enormous demands made on their time and resources, so to expect 90 minutes of inservice after a day in the classroom may be expecting a little too much.

Probably the greatest value was obtained from causing the staff to reflect on their current teaching practices, and in particular causing them to concentrate on what they thought were characteristics of a good lesson they had taught. This reflection and self examination has the long term potential, on its own, to enable improvement in classroom practice. The use of students on video giving their perceptions of Science was invaluable in this area. A student's perspective certainly made the staff 'sit up and listen'.

Given that many of the staff have been in schools for a considerable time, some resistance was noted (and probably would be expected) from some individuals to the interactive approach adopted by Gary. The 'old school' idea of inservice involving a transfer of information from lecturer to listener still pervades the thinking of some. With the absence of this, again, some negative feelings could be observed.

There was a perception, conveyed to me by several staff members, that Gary's method of presentation, while pleasant and non-threatening, was not really open to the ideas of the group. It was commented that he only wrote what he wanted to and that he had a tendency to misinterpret people's comments to suit his line of thinking. This perception was from my perspective unfortunate. What I saw was Gary trying to draw on the experiences of the group to illustrate the main characteristics of the conditions of learning. The presentation as a whole tended to lack somewhat in coherence from week to week. It was, at times, difficult to ascertain the point of some sections of the presentation. This could have been overcome by clearly outlining course objectives at the beginning of the course. Overall, I would consider the inservice as having been a worthwhile experience for both the staff and Gary. As a pilot study, it allowed several problems to be both seen and remedied. While from a staff point of view, it could have been more successful, on the whole the staff all learned some valuable information and some have continued their efforts in reflective self criticism and attempting to improve their student's outcomes.
Appendix F-Prototypes of Proposed Professional Development Model

Teacher Development Program
Phase 1: AWARENESS (why do I teach the way I do?)

Phase 2: REFLECTION (What does this mean to me?)

Phase 3: RECONSTRUCTION (Should I change my teaching and how might this occur?)
Appendix G-Years 7-10 Science Syllabus Aims

MINIMUM ACCEPTABLE AIMS

A MINIMUM ACCEPTABLE STATEMENT OF SCIENCE DEPARTMENT AIMS WHICH WOULD ACHIEVE THE BASIC AIM OF SCIENCE EDUCATION MUST INCLUDE ALL THE FOLLOWING:

1. To develop a lively interest in the nature and behaviour of people and the environment.

2. To develop an awareness of the importance of
   * thinking critically,
   * Science in solving problems,
   * persisting with a difficult task to a reasonable end point,
   * personal and community health and safety procedures in learning situations,
   * wise management of natural resources.

3. To establish a store of facts, ideas and laws which are important in understanding the nature and behaviour of people and the environment.

4. To develop the ability to
   * think critically, by
     . seeking evidence for claims,
     . applying cause and effect relationships,
     . being honest in reporting observations,
     . considering all available data and suspending judgement in the absence of evidence,
   * recognise a problem which may be solved by Science,
   * recognise patterns, generalise, formulate hypotheses, observe, experiment and establish controlled situations where possible,
   * use stored knowledge by
     . recalling information and ideas,
     . extracting information and ideas,
     . organizing information and ideas,
     . interpreting information and ideas,
   * solve problems,
   * use models (including mathematical ones) to make predictions.

5. To develop an understanding of
   * the importance of the abilities listed in (4) above,
   * the impact of scientific discoveries on society,
   * the limitations of Science in solving problems,
   * the effect of society on the development of Science.

6. To develop skills in communicating by
   * reading, writing, speaking and listening,
   * drawing, tabulating data, graphing,
   * using symbolic expressions, e.g. mathematical expressions, chemical symbols and formulae, geological legends etc.

7. To develop skills in general and detailed observations with the basic senses by encouraging students to
   * be aware of objects, scenes, situations and group behaviour,
   * look at recorded information,
   * listen to live and recorded language and other sounds.

8. To develop skills in observations, to extend the basic senses by using
   * measuring devices,
   * other devices, e.g., cameras, microscopes, recorders, projectors, ticker tapes, etc.

9. To develop skills in manipulating
   * laboratory apparatus,
   * field apparatus,
   * other equipment, e.g. simple tools, calculators, computers, audio visual apparatus, etc.

10. To develop skills in social interactions by
    * communicating,
    * co-operating,
    * organising,
    * tolerating other viewpoints.
STATEMENT ON CONTENT

This statement is to be used as a basis for selecting content which will enable the aims of the syllabus to be pursued.

In implementing this syllabus, schools will need to design a variety of science programs appropriate to the differing needs, interests and abilities of students. A more rigorous approach including quantitative work may be used in selected content areas for able and interested students. Other students will benefit from content chosen to develop particularly relevant and practical skills.

Content must be selected from each of the following 6 Areas, and in such a way as to give all students experience in each of Biology, Chemistry, Geology and Physics, keeping in mind that the environment does not present information as separate disciplines:

1. The things around us - within and beyond our local experience.
2. Natural changes.
3. Changes caused by people.
4. Processes of living.
5. Relationships between living things and the Earth.
6. Interactions.

Initial studies chosen in relation to each area should extend students' knowledge of the world around them and provide a basis for developing more advanced ideas, concepts and generalisations. Programs should reflect this intention by indicating:

1. an appropriate starting point related to students' experiences and the local environment,
2. some directions in which the studies may be extended or deepened, and
3. the longer-term purpose to which the studies are directed.

The social relevance and the history of Science should be made apparent by employing appropriate classroom activities throughout the course. It should be stressed that Science is a human endeavour and that the manner in which Science relates to people is of fundamental importance. Particular reference should be made, where appropriate, to the role of people in scientific achievements, especially the role of Australian scientists.

The understanding and use of computer technology is becoming increasingly important. Where appropriate and possible, students should have computing experience in their science courses.

The proportion of time spent on practical activities will vary with the content area. However, practical work including classroom, field and laboratory activities, should form the basis for the majority of the science experiences of students.

The statement is not designed as a teaching program. The headings need not be considered as separate topics, nor need equal time be given to them.
YEAR 7

1. SCIENCE SKILLS
   - LABORATORY SAFETY
   - MEASUREMENT IN THE LABORATORY
   - EQUIPMENT
   - PLANNING AND COMPLETING
   - INDEPENDENT LEARNER IN SCIENCE
2. MUSHROOMS GALORE
3. CHEMISTRY - WHAT SORT OF CHEMICAL IS THAT?
4. ASTRONOMY - THE STARS AND BEYOND
5. ENERGY
6. ECOLOGICAL PURSUITS
7. HOW SMALL IS A CELL?
8. WHAT ROCK IS THAT - THE ROCKS AND MINERALS OF THE LOCAL AREA.

YEAR 8

1. PUSHING AND PULLING - FORCES
2. ACIDS AND BASES
3. GREEN PLANTS
4. ARE YOU UNDER PRESSURE, AND FORCES
5. FUELS AND THEIR USES
6. CIRCULATION, RESPIRATION AND EXCRETION
7. MOVING ABOUT - MUSCLES, BONES AND DISEASE
8. METALS
9. BUILDING UP AND WEARING DOWN
YEAR 9 - 10

YEAR 1
1. CONTINUING THE LINE - REPRODUCTION AND GENETICS
2. INVESTIGATION OR BUILDING - A MAJOR PROJECT
3. CARBON CHEMISTRY - POLYMERS IN ACTION
4. EVOLUTION
5. HOW FAST AND HOW FAR
7. ECOLOGY - STUDYING AN ECOSYSTEM
8. AUSTRALIA - THE OLD CONTINENT
9. PRECIPITATE REACTIONS

YEAR 2
9. ELECTRICITY
10. EVOLUTION
11. THE ATOM AND THE PERIODIC TABLE
12. COMMUNICATION THROUGH WAVES
13. USEFUL MATERIALS
14. COORDINATING AND PROTECTING THE BODY
15. CRUSTAL MOVEMENT - VOLCANOES AND TRENCHES
Dear Professor Parker

I am writing this letter to commend to you the fine work being done at this school by Mr Gary Hoban of the School of Teacher Education. Gary has been visiting the school for over a year now, carrying out research with some of our students. His approach throughout has been collaborative and constructive.

I was present at the recent meeting of the Oberon High School Parents and Citizens Association where Gary outlined the work he has undertaken, and the sorts of preliminary findings that he is making. It was an impressive presentation, which addressed many of the core questions related to teaching and learning that we in schools must come to terms with. Those parents present spoke to me afterwards of their responses to Gary’s work. All comments were positive with lots of praise about the non-threatening manner in which Gary has gone about doing his work. The rapport he showed with the parent group reflects the same rapport he has with the students and the teachers of the school.

I think that we have been privileged to have Gary work with us. His credibility with us can only enhance the image of the School of Teacher Education among practising teachers.

Yours sincerely

Chris Tome
Relieving Principal
Appendix I-Interview Questions

INTERVIEW QUESTIONS

(1/12/94)

1. Did the program help you to understand your own teaching practice and if so can you give me some examples of how this occurred?

2. Do you think that your teaching has changed? In what ways has it changed?

3. What were the features of the program that helped you to learn about your teaching? In what way did these features help?

4. What were the negative aspects of the program and how could these be overcome?

5. Do you think that the program changed after Garry left?

6. Do you have any general comments that you would like to make?
Appendix J-Teacher Surveys 1 and 2

Survey 1 (December 1993)

PART A BACKGROUND

1. First Name: Surname:

2. What schools have you taught in and classes taken?

3. How many years have you been teaching for?

4. At the moment, what do you consider yourself a specialist in?
   (Tick as many as appropriate)
   (a) primary • (e) chemistry •
   (b) secondary • (f) physics •
   (c) science • (g) earth sciences •
   (d) biology • (h) other •
   Please specify

5. What teaching qualification(s), have you?

6. What tertiary qualifications (university, teachers' college,) concerned with science have you been awarded?

7. Are you doing a present course of study for qualification(s)?
   (Please give details)
8.(a) Have you any other qualification(s) relevant to teaching?
(Please give details)
8.(b) What professional affiliations do you have?

9. Have you been involved in any areas of responsibility within the
school(s) (For example, HOD, year, patron, textbook co-ordinator).

10. Have you ever been involved in other inservice programmes (do not
include teacher-only days) that relate to learning in science.

11. What do you expect to gain from this course?
(You might have a variety of reasons. List those most important to you)

12. Do you have any interests/activities/hobbies outside school that you see
as related to science/technology (e.g. watching 'Fast Forward', listening
to the 'Science Programme', star gazing, collecting shells). If so, what are they?
13. What has been your experience of science in school? (What was science like? How did you feel about it? What was your experience of it?)

(a) in primary school

(b) in secondary school

(c) in tertiary institution(s)

14. Have you ever considered or had

(a) a career in science Yes/No If so which one(s)?

(b) an occupation that you think requires an understanding of science/technology or uses scientific/technological skills Yes/No If so which one(s)?
15. Describe what you understand you feel about science teaching. To what extent, has your view of teaching changed during your career?

16. Describe a recent lesson or series of lessons that you have taught.
17. Describe what you understand and feel about student learning in science. To what extent has your view of learning changed during your career?
18. My understanding of the phrase 'Science Curriculum' includes:

Please circle the most appropriate number of the scale

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<td>knowledge and skills to be learnt</td>
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<td>what the student actually learns</td>
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<tr>
<td>the learning experiences for the students</td>
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<tr>
<td>what I teach the students</td>
<td>5 4 3 2 1</td>
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<tr>
<td>Other responses (please specify)</td>
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19. Describe what you understand about the science curriculum. To what extent has your view of the science curriculum changed during your career?
20. With regards to science,

(a) What do you understand by the term 'science'?

(b) How do you feel about science?

(c) Has your view of science changed during your teaching career? If so, please describe these changes and how and why you think they occurred.
21. Describe what you understand and feel about teacher (professional development) in science. To what extent has your view of teacher (professional development) changed during your career?

Thank you for completing this survey
MERRY CHRISTMAS & RELAXING HOLIDAY
Survey 2 (December 1994)

1. Describe what you now understand and feel about science teaching. To what extent, has your view of teaching changed during the course? Can you give me some specific examples?
2. What were the limitations of the program? How could the program be improved?
3. Describe what you now understand and feel about student learning in science. To what extent has your view of student learning changed during the course?
4. My understanding of the phrase 'Science Curriculum' includes:

Please circle the most appropriate number of the scale.

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<td>what I teach the students</td>
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<td>Other responses (please specify)</td>
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5. Describe what you understand about the science curriculum. To what extent has your view of the science curriculum changed during the course?
6. With regards to science,

(a) What do you now understand by the term 'science'?

(b) How do you feel about science?

(c) Has your view of science changed during the course? If so, please describe these changes and how and why you think they occurred.
7. The parts of the course that helped me most to develop professionally were: Please circle the most appropriate number of the scale
If these things didn't happen for you, then please write down nil.

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<tr>
<td>sharing problems and concerns with other teachers</td>
<td>1 2 3 4 5</td>
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<td>collecting and analysing classroom data</td>
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<td>getting feedback on the changes I have made to my teaching</td>
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<td>the workshop activities on the course</td>
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8. Can you sketch for me your model of how student learning occurs?
9. Do you feel that you learnt about teaching in this course? If so, can you tell me about the ways that helped you learn about teaching?

10. Are there any unresolved issues for you?
Appendix K-Electronic Mail Messages from Teachers

Garry Francis Hoban, 3/1/95 8:51 PM, To Garry Hoban re Policy Document

Date: Wed, 1 Mar 1995 12:51:49 -0800 (PST)
From: Garry Francis Hoban <gfhoban@unixg.ubc.ca>
X-Sender: gfhoban@interchg.ubc.ca
To: lblake@unixg.ubc.ca
Subject: To Garry Hoban re Policy Document (fwd)
MIME-Version: 1.0

---------- Forwarded message -----------
Date: 24 Feb 95 05:56:55 EST
From: GEOFF HASTINGS <100231.1405@compuserve.com>
To: GARY HOBAN <GFHOBAN@unixg.ubc.ca>
Subject: Policy Document

Gary,
Although not formatted properly on this letter, below is the first actual policy developed as a result of the project. I think it could still be better and would appreciate some feedback. We can also send over some examples of programs if you like as these are also the result of the program. Also, there is our faculty priorities or profiles that we developed. I will write them down.
ps I got your last letter and we will all send our ideas of learning in the near future.

OBERON HIGH SCHOOL
SCIENCE/AGRICULTURE FACULTY

WRITING POLICY
OCTOBER 1994

Writing in Science and Agriculture is designed to:

1) Allow students to communicate with others
2) Be used as a learning tool by the student.

Common Principles
1. Students learn best when they are allowed to express themselves using their own writing and language.
2. Students must be introduced to appropriate technical terms as judged by the teacher and in accordance with the stated outcomes of the program. These terms to be incorporated into their language.
3. A limited number of essential points will need to be given to pupils through prepared notes. In this situation the understanding of the pupils must be tested through verbal or written methods.
4. It is impossible to check all students' writing at all times but a maximum number can be checked by teacher review during the lesson or by the encouragement of students to read their writing. Teachers should formally acknowledge checking by marking in books and praising students where possible.
5. Teachers should value all attempts by students to express themselves so long as that attempt is appropriate to the level of the student's language development.

Printed for lblake@unixg.ubc.ca (Lorna Blake)
6. For assignments - the Faculty will place a large bias towards the completion of home assignments in original language. Plagiarism will lose marks. Appropriate use of technical language will be taken into account.

7. Teachers will mark student's work as frequently as possible.

8. Teacher will develop the concept of student review of learning through writing eg summarising.

9. Teachers will encourage the use of different forms of written expression eg the technical report, descriptions, creative writing, poems, summaries etc

Hope this is a start. We haven't even had time for a meeting yet but Craig is starting to get the taste for being a Head Teacher and I don't know how much longer I'll have him for. I haven't got anything back from you yet via Email so if you send anything, for the first couple send a fax as well until I'm confident that the system is working OK.

The sooner they appoint a Deputy the better for the professional development project. I don't feel part of the Science Faculty at all just now. Anyway there are more messages to come so I'll sign off for this one.

Geoff
Gary,
Re your last letter, we will do all this but the whole project has slowed this term because we don’t have time. It is not because of any sort of lack of will - everyone is really keen. The problem is basically that we are staying back a lot already and after school is definitely the only time we get to do anything. What we need is some more funding - there is little hope of anything coming from the school - we have had a 30% cut in T & D funds. The best hope is if I can get some external funding. This is the crunch - would you mind if I tried somewhere like Quality Assurance? I would have to get a submission together and would give you power of veto over anything that I sent. I think that to get anywhere now it is crucial that there is financial support - the three of us need to be out of school together - this is what really works, not when we are all knackered at the end of the day.
Please reply as quickly as you can - we will have a meeting about our ideas on learning and tape it but really it is pushing shit uphill without the support. And don't get the idea we aren't enthusiastic - far from it.
Gary,

Day was a great success but I haven’t as yet typed up the minutes and directions that we want to take. We have pictures and diagrams but the day turned out to go into a completely different direction to the one that I had planned on the agenda - but it was completely different to the direction I expected.

We are looking at assessment and ways to ‘freshen’ up the student feedback - we feel the tapes are starting to date because we don’t think they reflect the student experiences as we are teaching now - so we are looking for ways to get student feedback - self assessment and learning logs have been mentioned. This has created a whole new direction for us - how to ‘move on’ to the next step.

I will type up the whole meeting and send it over. I also have 2 90 minute tapes that are completely full. It is a matter of doing it. I am starting tonight

Cheers Geoff

Printed for gfhoban@unixg.ubc.ca (Garry Hoban)
GEOFF HASTINGS, 7/5/95 1:04 PM, Minutes

Date: 05 Jul 95 09:04:36 EDT
From: GEOFF HASTINGS <100231.1405@compuserve.com>
To: Gary Hoban <GFHOBAN@unixg.ubc.ca>
Subject: Minutes

Gary,
Below is the minutes of the day. It doesn’t seem much but it summarises much toing and froing and discussion.
The first part of the day is involved in the development of the model that follows.
Faculty Development Day June 1995

1. Meeting Minutes

Geoff. Do we need to get an evaluation sheet to look at the success or other wise of what we are doing?
General agreement from David and Craig. Discussion re the necessity to get some sort of feedback
whether what we are doing is successful - to look at whether we have achieved the outcomes and to give
opportunity for general student reflection on the success or otherwise of the topics.

Suggested that a sheet be handed out at end of some sort of learning period - at the moment it would be a
topic. Much discussion about what sort of questions could be asked and how we could best go about it in
light of the learning project.

This sheet would be used for teacher feedback - to take the place of the tapes as these are getting to their
use by date. Could get feedback on what parts they thought were relevant to their lives, what parts they feel they know well and why, what parts they didn’t understand and why.
Contributions from all three participants.
Questions could include:
1. What things that happened in lessons made it easy to know?
2. What things that happened in class made it hard to learn?
3. What parts of this did you enjoy?
4. What parts of this didn’t you enjoy?
5. What things can you do now that you couldn’t do before?
6. What other things would you liked to have done or spent more time on in this topic?

Much discussion but these questions thought the most likely.

Pointed out by both David and Craig that no name need go on the sheet - this could cause problems but it is better to create a climate of trust and responsibility. This must occur or the process is useless.

Problem bought up by Craig - time aspect of teaching this way. Feels that he especially cannot keep to the
time restriction necessitated by the content to be covered. No answer to this. Geoff’s response is that it is more important that certain ideas are learnt properly than a huge amount is covered for the sake of

Printed for gfhoban@unixg.ubc.ca (Garry Hoban)
covering it. Important students who need more time have the opportunity to access it - it is up to each person's professional judgement how they use time. There are other alternatives especially in Year 10 that we can pursue. General agreement that Year 7 is too long and a topic must be pulled out. To be decided next term.

Craig - question that comes from this - has our assessment techniques kept pace with our classroom teaching methods? General discussion and agreement that our teaching has moved but our assessment methods have not. Also agreement amongst all three that we must look at our assessment methods if our teaching style changes are to have validity.

General discussion over considerable time - Input from Wendy Hastings - CSU Lecturer

Assessment ideas
1. Tests when students feel they are ready.
2. Tests - set minimum standard - students can have a second chance to achieve that standard.
3. Group Work - suggestions - Peer assessment
   - other teacher assessment
   - chips in the middle (students throw one in when they have made a contribution.
   - Based on presentation
   - Combinations
   - other

Action Plan

1. See Schools With Innovative Assessments
   - Extend network by - Gill Mullholland
     - Gary Hoban
     - Craig's contacts
     - Geoff's Contacts.
     - National Schools Network
     - John

Time Frame - Rest of Year with 1996 introduction

2. Broaden 7 & 8 in the short term for 2nd half of the year
   - Tests 25 %
     - Group Work - 15 %
     - Problem Solving - 15 %
     - Assignments 30 %
     - Attitudes - Satisfying our outcomes 10 %

This change to be articulated to students and parents

   Regards
   Geoff

Printed for gfhoban@unixg.ubc.ca (Garry Hoban)
Gary,

I have drawn up an image that represents what we feel is the model of the process. We made it as simple as we could but realised it is a complex process with lots of interlocking and vital Factors. Could you send your fax number. I was going to send it by email but didn't know how up to it you were on graphics at the other end. If you can handle JPG images or MacPaint images I can send it straight away. It has to be a compressed type - not a BMP file as it would cost me a fortune otherwise - any graphic is big. These types are compressed and so much easier to deal with.

PS I could send you a .ZIP version but can you UNZIP it. Do you know what I am talking about or do you think it is your fly?

So if the above is gobbledegook then just send the fax number. I will get Wendy to send it from CSU.

pps HOLIDAYS ARE WONDERFUL THINGS

Regards Geoff.

ppps Hope the Minutes are OK - the tapes should flesh them out.
Gary
Answer to your question is that the research material has played a
much larger part for me than for the others.
The research has played a part for the others through me proposing
ideas and stimuulus material.
This was also your role as well when you were in direct contact.
This part of the role of the "outside" person in the process.

Geoff
This is the group 1
Does it make sense
- it is a complex relationship
Group meeting to discuss features of the model, June 1995.

Geoff: Is this a one off event, is this process transferrable to other contexts? Is this professional development idea which is a long term thing about a theme where you keep coming back to the same sort of theme, I guess that is the principle of it. You start with a theme or a motivation and you keep coming back and back, well that is what I think it is, you keep coming back to the theme of how students best learn.

David: I reckon that unless you have staff that are wanting to change and are willing to change, this won't work. Because it requires effort and resources and time and if they're not willing to put that in, then I don't think it will work.

Craig: It has got a central theme, but you have to play around with that. Everyone can go off and try things.

Geoff: Well that is it. You are not being told this is the way you should teach your class. You are taking it on board and working out your own personal, well that is how I see it anyway, your own personal way you are going to improve your teaching.

David: It is a hands-on way of learning. You try things, you re-try things and talk about it.

Geoff: Yeah I want to get to that. Starting off we want to think about. What we want to do is try and work out exactly what works for us, what causes each of us to change. Have you got those pieces of paper we did before?

Geoff: Yeah it is on my desk at school. I think the best way to do it is to think of one thing that worked and why you did it and why it makes your teaching better. So what is one area of your teaching that has changed? It can be a really specific thing like one thing in one topic.

David: I think it is more general than that. My way of thinking of it is that when I come to think of something like how I am going to teach this, this sort of thing comes up in my mind—how the kids are going to learn it and then it ticks over from that and then go through from there. Like we may start here and then go there do this that and the other. That way I think it will all fit together with the kids and I think the kids will learn by doing that, some kids will learn by doing that—Try to get a variety of different types of lessons and different topics going so that if particular kids don't learn one particular thing in one little area then they will hopefully pick it up doing something different the next day.

Geoff: So you have an overlapping, complex sort of situation.

Craig: Similar to a red hat. You have got to try things in a different way for different kids. You try to think of the best way to do it for the kids but to actually say why, that is really difficult. It just may seem the right thing to do. Also it may be different for different kids, even though it might the best method for six different kids it might be best to do it another way.

David: I think too, and I am only starting to realise this—that with different kids and different classes have different characteristics. Like sometimes with the top 9/10 class, now that I am doing—I have gone back to being much
more structured sort of do this, do that, a worksheet every now and again, do this prac and that, sort of much more as I used to do it this term and the class has been alot better. It has really settled down alot particularly in the last week, I really have noticed a big difference. They seem to much prefer that type of structure whereas before, I tried to do different things, send them out everywhere and this sort of thing and they get lost.

Geoff: They are not self-directed.

David: No. I think in a way you need to, I am starting to think, look at the kids in the class and say "Rightio, that class is like that and so I have to teach like that." You can try different things but as a basis, in general, I think you need to teach how the class responds to what you do.

Craig: With this year 8, I can let year 8 go with a problem and they'll go off and do it and have kids everywhere whereas with that year 9/10 class I find the same thing as David—that the kids won't do things by themselves. I don't know if it is because of the programs, the year 7 and 8 programs are more general and they can go off and do things whereas the 9/10 program is more specific and because the content is more specific it is harder to find things for them to go off and do by themselves. Like I am teaching chemistry at the moment like mainly compounds and stuff like that—it is pretty specific—they can't really find, well they can but they have no way of understanding it. So depending on the program it depends on how flexible you can be.

David: When they feel that they are not learning, when they feel that they are not doing things the way that they learn, then they tend to get ratty and they tend not to want to come to class and not learn anything—that is when I feel that your classroom management comes right into it and it becomes alot more difficult. If the kids aren't doing things the way they want to do it.

Geoff: Do you think it could be a factor of the way the sevens and eights have come up with a system where we have all been trying to, well the sevens and eights have sort of been trained that way in that they have been bought up in a classroom climate where they are not used to anything else and so they know what is expected of them. See because I don't think that this looses any validity for the whole idea the fact that you are teaching that way, in fact I think it is making it even more valid, because you have thought about how your kids learn and how they can best learn and you have said "Right this worked for this class" and I think that is equally as valid as having a lesson where the kids are going all over the school doing lots of complex things and self-directed things. I think it is still equally as valid because it's working for those kids, and the thing is that you just don't do that. What you do is you think "How are these kids going to learn?" and this is where I think the crux is—you now think "How are those kids going to learn?" and you teach the way the kids are going to learn and that is what teachers don't do. Teachers teach the way they feel comfortable teaching, this is not the way they think the kids learn. And this is where I think, well I know that is where I have changed, that is really the biggest impact. I do the same thing as you do in fact, I was surprised, that's interesting, and I think about it the same, it is probably
the same as Craig, I don't know. But when I am starting, I try to think well
"how are the kids going to learn this?".
Craig: It's funny, that 9/10 class, there are a lot of kids in there that I had last
year and I can let them go on and they do this and that and they can go off and
actually do it, but the year 10 kids, the year 10 kids want to sit there and they
want you to shovel the information down their throats—they are the lazy
ones who don't normally get up and do things. What happens is if you give
them a task where they have actually got to get up, it's like the other day like
in the room they had to go away and construct a table themselves based on
the information that they thought of. Rather than me say look at the colour,
look at the metal, they had to write it down and put it into a table. Now the
year 9 did it really well but year 10—not very well at all. They wanted me to
basically sit down and tell them what to do and that is a really distinct
division in one class, which makes me think that you give one group of kids
one way and another group of kids in the same class a totally different way of
doing things—or you just settle it by doing it this way because, and force the
year 9 kids to do it and makes things happy and let the rest go or do the same
task the way the year 9 want to do it and then get the year 10 together basically
get them together and give them the information the way they want to do it.
I don't know which is the best way to go.
Geoff: The fact that it is so general to me, like anecdotally, seems to indicate
that the way we are teaching with those kids is changing, like they are more
willing to express their natural ideas, whereas the year 10s are performing to
expectations.
David: Or is it just that the year 10 are an odd group of kids?
* AGREEMENT. Geoff: But I find it interesting that right through the whole
year, it is the same sort of story because I'd agree too that my year 10 group is
the same and I find it interesting that you wouldn't expect that as such, I
wouldn't have thought but it will be interesting to see what happens next
year. All I can say is try to keep the year 9s going the way they are as much as
possible but you still have to manage your classrooms. It will be interesting to
see what happens next year. But that's the crux that has come down to me
that I think about how the kids are going to learn. OK, so now what we are
going to do is to think about why we do the things we do. I know for me I
taught the way it seems best for me and sometimes the way it was best for
them. So let's—we can agree on what .......... we got so let's try and agree on
how we came about it or what worked. Where do we start, is it a simple thing
that we can put down on paper or what?
* 1. TAPES
Craig: For me, the only reason I really looked at it, had any idea of what was
going on inside their minds is the fact of those tapes. Now I don't think—if
you sit down with half a dozen kids and say "OK, what do you want to do?", I
don't think they would have been as frank or as descriptive because you just
asked them. But the fact that Garry sat them down and asked them a few
questions and taped it and got us to listen to it, that is the only way that I
would have been able to see exactly what is it they think. I don't think it could
have been done any other way. But you can’t sit down with kids and say “Well, what do you think about the way I am doing things?” because they are not going to tell you because they think you are getting up them.

Geoff: Yeah.

2. YOUR IDEAS

David: But it takes you a while to have a framework from where you are working from to sort of branch out from there to prompt other thoughts and side tracks and so on.

3. MOTIVATION

Geoff: Yeah, even if it just a motivational thing. That’s what I thought too, and I agree with Craig that there is no way that anyone in this school could have done it.

4. OUTSIDE HELP

David: It had to be someone from outside.

Geoff: It had to be someone from outside and someone who is perceptive and knew about kid’s learning and so could ask questions as they were talking and bringing out. Even though Garry reckons he just let them talk it is important to know what were the right questions to ask to make them talk.

Craig: Garry could have written it all down and came to us and said “This is a summary of what they said” but I don’t think that would have had as much impact on us as hearing the tapes. I think that was probably a key thing.

5 WEB

Geoff: I can agree with that so everything branches out from there. Is it a linear process where the ..........leads to something else which leads to something else which leads to something else do you know what I mean? Or is the tapes?

6. DISCUSSION

David: I think discussion with colleagues is important and sitting down and just saying “Look this is what I tried and it failed” or that type of comraderie sort of thing. I think if that wasn’t there, you have to do it on your own and I think it is a lot harder doing it on your own rather than working as a team.

Craig: It is amazing when you sit down and talk, often how things just come to you.

David: Like everyone says about the 9/10 class, I didn’t really think of that.

Geoff: Yeah.

David: I just thought oh yeah, “Well maybe my class is unusual”, it’s an enigma or something, you all find the same sort of thing.

Geoff: Yeah, but the only thing is you only get a chance to really talk about it properly when you are out of the school and you are sitting down and it is a time thing. There are days like this and you can come back to it and refresh it so you don’t have to worry about the year 11 year meeting or the boss going on and all that sort of thing.

Craig: that’s what I have found on PD days, mostly it is a waste of time.

David: Like when they have a day and they

Geoff: You need to get out I think and discuss and when you discuss you sort of tend to start to reflect about the framework especially ....and I agree with
that and I reckon you couldn’t do it in a threatening environment. You know it is “Change or else” or “You’ll be marked”.
Craig: I think that one of the features „people like where they tell you what you should be doing—there are no ifs and buts about it—this is what you should do.
Geoff: Yeah it gets up my nose.
Craig: Like they are telling you to teach one way but that may be a way or it could be valid but as soon as someone tells you what to do you just turn off. Geoff: Yeah, I don’t know what you guys are like but when I sit there and listen I also tend, like I was crook last staff development day and I wasn’t in a very positive frame of mind anyway but when Kate comes and tells me about left brain and right brain, she is not teaching my class and she doesn’t know how I teach and I tend to get very negative about it. Whereas what I do with that, where that does come in useful is where I things like, not so much left brain right brain stuff, the idea of different learning styles and you know the kinesthetic stuff and visual and auditory, things like that, I tend to absorb that and put it into a framework and put that into a framework of this in my classes. And think “OK there are kids that I can teach this way and learning is a complex process so therefore if I have all these things then the kids are going to get something out of it”. So that writing day was the same, remember that slack day whatever it was. I looked at it and I thought, OK here’s some ideas but I didn’t think that actually—I couldn’t see any point, and I couldn’t see any point to say “Oh, I’ll try this way“ or Oh, I’ll try that or I’ll try this” and it’s all in isolation. There’s no great change in your teaching.
Craig
Geoff: Yeah I’ll do an exercise in word structure or something like that, and I thought “What a waste of resources!”. In that respect in that what you are going to do is try one little exercise in your class”. But if you take it on board as part of your big picture it is better
David: I agree with that. I think those days are a waste of time—that’s my opinion. That SLACK day, I remember, and to be honest I think back now cause I can remember doing the literacy across the curriculum part, I can remember very little else about it apart from teaching English basically or teaching communication skills across the curriculum.
Geoff: Yeah.
David: I can’t remember a thing about it.
Craig: We had enough, we had Sandra.
David: Yeah yeah,
Craig: Like Sandra didn’t take it over,
David: Well that surprises me!
Craig: There was a lot of issues to do with English and writing and stuff and it just so happens that Sandra was there knew I was there and so we spent alot of time sort of English issues and stuff, reading and writing and why they do things and that. Actually it was quite interesting but it got right off the track and we weren’t really doing what we were there to do. The SLACK was about ways to do things, they were all individual things but I suppose if you got
right into SLACK and said “Right I will try these things and then you do one thing after another and somehow get them into your program, I still don’t know....so
Geoff: Yeah, writing by itself isn’t going to do it, you have to do other things—it has to be part of a package. But I come back to the same point, this is what I have come to understand more than anything else is the complexity of learning and the fact that it is not just one factor that is going to change the kids learning in a night because it is a whole combination of things and it all influences how they go under that. But don’t apologise about Sandra.
Craig: Sandra didn’t take it over it is just that she knew alot about it.
David: She just started talking about English that was all it was
Craig: So Sandra just started talking about all those things so it just happened to go around that way
Geoff: That’s what happens, believe me, you only have to be in executive meetings to know that.
Geoff: OK so we agree that the discussion and the time aspect is important and the tapes and the outside agent.
David: Looking at programming is important too.
Geoff: Does the programming give it a, to me it gives it a practical structure.
David: It is a base to work from.
*PROGRAMS
Craig: Programs ..........the administrative type of thing what you do
David: I looked back the other day at some old stuff, the old programs, I don’t know why I picked them up around here actually. They are just completely different from what we do now. They are do this, do this, do this, do this and that is basically what it was. And just looking at the contrast between different ways of writing a program. Our programs now are fairly general, do things in any given way. This is much more talk about this, talk about this, kids write this, that sort of thing. It was the way they were almost written sort of thing.
Geoff: I hope that our programs encourage professionalism between the three of us in that they encourage individuality—they have certain things in common, the outcomes are in common but they certainly encourage each of us to teach in different ways.
Craig: There are far fewer things that and they sort of cover a certain topics, do this.
Geoff: Yeah, sort of getting to a core of knowledge, maybe or something a bit similar. I mean probably someone like the University of New South Wales would kill us for that. But if we give them en
David: If you listen to all these statistics and speakers and that, all of them say that it is far more important to teach the kids how to learn rather than content. And I thing what we are doing is giving the kids far more that Craig ..if you do well at public schools rather than private schools. learn to do things better rather than shove it down your throat
Geoff: That’s right that’s what the statistics say. Right, the discussion so far we sort of fairly well agree the TAPES, the DISCUSSION the TIME is important, out of the school and not, well for me, the worse thing for me is to come back

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after school from 5 to 9. I think if you want quality teaching you have to put in quality money basically, which is get people out of school and doing it in their WORK TIME. I don't know what you guys are like but if I stay back after school all I am thinking is I'm not home with the kids, Wendy's home minding them again.
David: Especially if you have other things going on that you have to do
Geoff: Whereas if you are doing it as a job and my job is paying me to improve myself then if they put the money into the day then I feel more obliged to put in a quality performance.
Geoff: People rabbit on but I really think if you look at other people in the workforce they are off and productivity drops off anyway and it decreases and I don't think that you can expect people to stay there from three to five and so you can get started again
David: Some people work better in the mornings some people work better late at night, that sort of thing too. It is a creative thing, you have to be creative and think of new ways of doing things. People sitting at a desk, I often think of things while I am mowing the lawn, going to bed at night, ticking over in your mind.
Geoff: Yeah I am big thinking on the toilet.
Craig; You come up with your best ideas in the oddest of places. I get out there mowing the lawns. You are out there doing something different and then all of a sudden something else, and then you think of something
David: I think tied up with that too, another to me, I think it fits in with that is time to actually—if you have a lot of pressure and alot of things, I find that I don't teach as well. I can come home and I don't have to race around at school and whatever, I find the next day is often better. Because you are just more relaxed and that sort of thing
Craig: If you have time to and figure out what you are going to do you don't feel that you are in a, you are in a better mood I am not sure if it is the night but you don't feel. Like some lessons you feel that I could have done a better job. You come to school and you know that you can bumble through the day but normally . You are stressed to start with because you are wondering if it is going to work or not but if you have some time to think about things then things.
Geoff: Another thing that has been important for me has been actually seeing and feeling that things have been working in the class and getting FEEDBACK from the kids like seeing the kids actually learning something, that sort of feedback has been really important for me.
David: Seeing the kids learning can be a satisfaction. Your satisfaction drives you on—"I've done that well, now OK I am going to do that, I want to do better. You've got to have that recognition, you don't get it from anywhere else really except from the classroom, you walk around and stuff or "that went really well". You have got to get that feedback or recognition from the kids. Very rarely does someone else tell you, that is pretty rare. If you can recognise the change in the kids or the kid picked that up or I feel that something worked really well, ..

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Geoff: It is an interesting one that you raised an interesting point about recognition from anyone else, you wouldn't rely on parents because if you do a good job they don't say anything and if you do a bad job then they do it behind your back but I mean in terms of your colleagues, that is an interesting one. I mean I am not quite sure, yeah I am interested.

David: You know when you walk into my classroom it is always at the worst possible moment. It is always is. I don't think you have ever walked in at a time when I think, gee I wish Geoff was here to see this.

Geoff: Sorry. (Laugh)

David: Ten minutes later when things are going really well and really smooth, I wish "Gee I wish Geoff would walk in here ten minutes later". Geoff: I don't think I have hardly been into your classroom and think "Oh gee this is not going very well" so it must be

Craig: Well, there is

Geoff: Do I do it to you too?

Craig: Actually you have walked in a couple of times and I have. I find that no matter how well your lesson is going there is always five minutes or ten minutes here and there for some reason the kids go ...and people like walk in the room. They must think

David: You know that it doesn't worry me.

Geoff: I mean my class is in total chaos too.

David: I mean the three of us it doesn't worry.

Geoff: Oh well that is good I mean

David: When walks in well no worries

Geoff: That's good, I'd hate you to think that

David: but when parents walk in I get a little bit worried

Craig: But it depends who you have got. The trouble is that when the bell the bell looks like a disorganised mess. Some people in community might look pretty funny. The trouble is that they form an opin

Geoff: Here you go we must be doing something right. I mean you are always going to get people up us for the rent for little things that go wrong and that is going to happen—that can't be avoided. If it is justified criticism you have to take it on board and try to do better next time. If it is not then you ignore it.

Lyn Montgomery was saying to me the other day and Lyn is not backward in calling a spade a bloody shovel and she said that lots of things from around the community that the science faculty has got a really good name. Now you may have heard something different but you might not have heard anything at all. But I thought well this is an independent person who ......they would not tell anyone else, that they are very impressed with

David: I have never heard anything negative but when I have been in shops they have said "Science, oh that is really good". I have picked that up a few times. No-one has ever come up and said "You are doing a really good job"

Geoff: No-one ever will. I've had one person in my entire career that has said that to me and he was a lecturer at Charles Sturt University and I taught his son and he said that you are doing a really good job, It just doesn't happen. So I think right things must be happening.
Craig: I have heard kids bag the school but I haven't heard anyone bag science.
Geoff: Alright so right things must be happening. I think we should pat ourselves on the back. With any other information we should give ourselves.
Craig: I had a really good conversation with John and .
Geoff: OK so for me if you change and it works then it becomes a self-feedback things so that is like student feedback.
Craig: You know I have had a few new students come in and one of the new said, he used the word “Bludge”. She said this more of a bludge than my other school, like we so ......I got the impression that she did not and she came in later
G Is there anything else that you might have on your sketches?
Craig: The first thing was assessing what they said compared to what I said. And then breaking it down into good things, bad things and sort of OK things...sort of improving things. Like the OK things the idea was to come and try to muck around. Like the time thing
Geoff: I haven't thought of that. It is sort of like the PRIOR KNOWLEDGE part of it. That's like
Craig: My original ideas are the basis of my teaching in the past. It is the confrontation between their ideas and your ideas makes you think about the whole thing and
Geoff: Yeah, that is pretty reasonable so that is like an input into the process as well. Are there any other inputs or parts of the process. Like the output is basically CHANGE. The thing I find is that doing all this and I think that you talked about it today is that doing all this gives me better understanding of how the kids learn and that's important so influencing what I do. Do you agree with that? Like the big difference is how it has affected your teaching. Yeah, and I think that is how it has affected my teaching too I mean I think more deeply about what I do.
David: It is ....... I think no hang on
Geoff: Which also brings me to another point. I wonder if you had three teachers like us and you had a deputy who comes down upon you like a ton of bricks, I wonder how it would have
Craig: There are times when I have had kids doing stuff in the room an kids in the creek and I suppose if something happened down the creek.
David: This is where I get a bit worried sometimes, I Physically couldn't get around to the sites. I thought this would be interesting
Geoff: Can I say how I feel as a supervisor in that if John brought that up. First of all your duty of caring is basically if you put yourself in the position of what a parent would do, that is your duty of care. If you said be careful, be . I think for us to satisfy the learning environment that you need to take a risk. The discussion and collegiality is important. And that is like classroom management and you are good at classroom man
So what have we got lots of circles, diagrams
David: Is there somewhere in there try it in the classroom and if it doesn't work change it.
Geoff: OK so this leads to change
David: Yeah so try it in practice and then reflection on our part.
Geoff: I think this whole process where we have had to go back over our own teaching encourages that. That is where I think the teacher tapes are important because for me it made me think about my teaching. I don’t think I gave it any great insights on the world but it made me think.
Craig: So basically I modified things
David: kids

KNOWLEDGE BUILDING COMMUNITY
Geoff: The other thing I thing that I thought was critical to this was Garry’s imput, not just in the tapes. The actual input and he started the process rolling and talking to us and that.
David: He had a general idea although he did not have any specific goals, he had a broad picture.
Geoff: He had the big picture and got us rolling. I don’t know, I hate to say this Garry but I don’t think we need him so much anymore. It would still be great,

David:I don’t know about that actually. I reckon, I think in a way we might be reaching a point that from my personal, where I am up to, where I need something, something, a new section or a new something to concentrate on to work towards. This seems to be going OK and this is just a matter of continuing teaching and looking at the classroom changes and that. I am not sure if we haven’t done that or going back and resurveying the kids and looking at change.
Geoff: OK so what you basically are saying is that the stuff that we did two years ago is probably reaching a use-by date.
David:Umm, I think, I mean in terms of developing yes,
Geoff: Yeah.
David:I think, we will continue use it for ever and ever and ever, that is my way of thinking, ummm, but to keep going back and looking at the same thing again, I am just not sure that it’s getting a bit stale.
Geoff: Yeah.
David:Whereas if we had another, I haven’t got any real ideas, another direction we can sort of go off on a tangent or something, something new extended from this, something to sort of keep our thinking going and that type of thing, I think that might be what we are needing, or what I am needing.
Geoff: Yeah.
David: As well as keep going on this sort of thing.
Geoff: Do you mean that in an understanding of learning thing or in more a broadening of, broadening of horizons like what sort of tricks to use a better word have you got up your sleeve type of thing? Do you know what I mean?
David: No, not exactly.
Geoff: Alright, do you need to go into a new direction to understand about how the kids learn more; the actual process of how you should go through preparing a topic like that or are you more talking about what sort of things you have got at your disposal to pull into that?

David: That's more that type of thing, yeah.

Geoff: You are pushing the frontiers of what you know about science teaching in other words?

David: Yes, yeah, why don't you go on a bit further?

Geoff: Yeah.

David: Looking at it from perhaps an outsider's point of view, looking in and bringing more things in or something, like working on a new strand type of thing. I am just not quite sure. In a way I think by looking at the kids again and seeing if they can pick up change, I guess it could get a little bit personal here. In some ways I would like someone, a kid, to have a really good talk about it sitting in my class what it is like. I think that would be really interesting. It could be really nasty too, but it would be really interesting to get a kid's perspective of what I do, how I do it and their interpretation of it.

Geoff: Yeah.

David: What they think conjures up a good teacher, what they think conjures up a bad teacher and then looking perhaps looking at something from that angle.

Geoff: But what if survey of one

David: Same students doing it more than

Geoff: I have been thinking about it as well and I can always improve, I was thinking if we need And I think we need the kids to give us more direct feedback on our teaching.

David: I think that is not a bad idea actually. It needs to be about

Geoff: I have done it with my year 12 class and I have done it a couple of times and it is quite good and the kids were quite good actually most of them felt that I didn't get the message across.

Craig: Not getting the message across depends on the kids you have. Because you can do one thing one way and they are going to get it, and if you know that they don't get it you can come back the next day and do it a totally different way so then they get it. But you can do the same thing with a different group of kids the next year and they get it the first way rather than the second way. I have never written it out and with the year 12 kids I asked if they don't get it. I went through a writing and assessment task but I don't think that I have enough time spent going through it. But that sort of feedback is what we need. That is the key thing to see

David: Some of the kids are really quite and I think sometimes you can

Geoff: I don't know I will just throw that in, a set piece of paper. What did you learn what did you enjoy

I think that the process for improving my teaching and he
Craig: Garry is separated from the three of us and he does not. He is the one to talk to in terms of try this and thry that and you need a network and you need something like

David: This is where I am at, right. I feel with science teaching that we teach far too much that justifies for the classroom. I would much rather teach science looking at issues and things that are relevant outside the room in the local community, internationally and globally. My way of thinking, is that I personally think that we concentrate too much just on what we do in the classroom. I would much rather bring in bits and pieces that are in the news, much like English...Cathy is doing stuff on euthanasia and she was doing stuff on rainforest and green issues looking at pros and cons and that sort of thing. To me that is more teaching, getting kids to think through things, think through issues that they are going to face. Think through genetic engineering because they are the one that are going to be making the decision in a few years time. Whereas now we just teach well this is genetic engineering, blah, blah, blah, not looking at the actual process of going through and changing laws and all that sort of thing. And to me that is where I would like to take my teaching.
Transcript of final meeting to revise group model
(November, 1995)

Geoff: Just going to start to talk about the group one now—it's complex isn't it?
Craig: I remember doing this?
Geoff: It was in the morning, I just remembered. I was not very happy with this model because it's too complex. I seem to remember that when we started it got more and more complex as everyone had new brainy idea.
David: It is possible to make it simpler?
Geoff: I don't know if there are really critical parts. I may put it as a central thing and then everything else started with discussion. And what's the thing that actually kicks it off, to sort of develops that and starts to roll? I know what it was for me, it started with the interviews.
Craig: Well the discussion was based around that.
Geoff: What's the starting point? I also thought me and sitting in talking in the interviews. If I just talk into a tape..
Craig: Would it necessarily, probably the right things to do. So you could have talked in the tape for six bloody weeks.
Craig: Ya, he's probably right. I'll agree with that.
Geoff: So what we're going to start off with, that the student tapes lead to the discussion, but then collegiality then became the crucial focus.
David: Yes, the motivation.
Geoff: Well, I think also the tapes kept it going because they came coming back to it and that gave us sort of a focal point to start from. What develops the collegiality?
Craig: one of the things is you've got time when you don't want to do it.
Geoff: Ya, you don't have like a shared goal or a shared vision or something like that.
Craig: And had a probable idea to whoever that's in the group. We could still discuss things and argue it better, but I don't know whether you'd get as far.
?: That's to bring about change. I've thought about this a lot. If I didn't you two guys and I was sitting in in a staff like Kelso
?: (inaudible)
Geoff: ...where there's people who don't want to change, would it have been effective. But I still think it would be effective because I think there will be some change. You wouldn't get any change and really reflect the teachers, but you get some change.
?: (inaudible)
?: We're sitting by ourselves in this bloody room.
Craig: Hm, it makes it impossible.
?: Geoff: All right, so student tapes lead to the discussion. I still argue that my interview started me reflecting on my teaching. It made me think back about, like why do I do what I do.
David: Yes, I agree.
??: And put me into sort of a reflective mode and ____ what was coming from the tapes. Because you said things that in hindsight, when you looked at what was coming back, ____.

Craig: The kids had spoken to Gary and there are some big differences.

Geoff: I agree with that. I think we all pretty well agree that we’ve got two inputs and maybe it was the comparison between the two inputs and the start, the reflection, that adds to the discussion and the collegiality and I think this is crucial—this thing can’t be done in a day, it’s like years, it’s really a long-term thing. And you need time support. It’s no good rushing about in-between lessons trying to do it or during your lunch time. You need some sort of support from the school.

Craig: That’s the next step. Then after assessment, you might come across something else.

Geoff: It might lead to something that might need another 12 monts.

Geoff: I mean at least we’re looking at what we do critically.

??: Or makes sort of a change or ____.

??: Right.

??: We might never get to ____ later.

Geoff: I think that’s probably true. I think because teaching is problematic by nature because you’re dealing with the individuals and kids and all sorts of different opinion and insights. But I think you get closer to one.

??:(inaudible)

Craig: I don’t know what it proves anyway. They will change every single year.

??: What a good point, that’s true.

??: Because it’s never going to be the same.

??: Ya.

Geoff: So that leaves ___. I don’t know that you guys like. So we got this ideal collegiality and you try things in the classroom and some things are working and some things aren’t. Even though they’re not working..

David: In some ___. I’m surprised if he sort of ‘I can’t learn it this way’.

??: Oh, really?

David: Ya. And I said well, how do you learn? And that one happened recently. So it’s nice to know what things do. And you get ___, too. ____ There was one voice? ____ oh maybe I should have agreed. It’s totally unbelievable.

Geoff: I just had this wonderful lesson with year seven and it is working so well And they do this astronomy thing and it’s for 15 points and it’s oh, it’s just so working so well. It’s terrific.

??: In ____ we got, our astronomy program is they have alternate task that they could pick one. It’s the one I mentioned on the tape because I think it’s a real success, I’m convinced.

Geoff: I even had a kid.. you know, remember what I said about the assessment, about I’m doing a presentation, one of the kids said to me can I do it after school? My mum can come in and...

??: You’re joking.

GSo we’re going to do it after school.
Geoff: Around the table ya, this is around a table. I don't know how it's going to work. I hope it works. So what have we got here. We've got programming. That's an output. What's programming __. If we're going to change, as it leads to alternative, things that will lead to alternative programming.

?: I think it's essentially sort of __ programs.

?: (inaudible). What you're going to do. You might put new __ program and this fits it.

Craig: You come up with the goods basically, isn't it?

Craig: Ya, rather than saying we're only going to do this and try to work off it.__. But in that way it's better because you're putting in the program what you think is probably better for the kids.

Geoff: The class will learn __ of programming, we just say the way you're programming. I mean we're programming the outcomes. We're not programming what you should do in the classroom, which is very different because they'd never work probably under the old system. But if you're working on a __ of you will learn different things, specific things. The way we're doing is we're programming outcomes between you can learn any way you like. Could you do this under an alternative programming system?

Craig: __. You cannot necessarily do something in the programming __.

?: (inaudible): __ have the kids say we'll this interests us, can we do something on it and __.

Geoff: What about Gary's role in all this. We've got Gary as the outside agent directly inputting into the change process.

David: Probably sort of the instigating coordinator and he had a vision.

Geoff: I don't know that he did. (laughter)

?: He has some kind of ideas.

?: Ya, all right.

?: And __.

Geoff: And he also was a great resource base. So you had somebody outside looking in who had access to a broader knowledge or a broader experience than.

?: I think like it has been a bit of a void

Craig: Now, Geoffrey has been organizing stuff, but that's different though from what Gary's role is.

?: Ya, I agree.

Craig: But he's just there, someone to talk to and generate discussion and ideas.

Geoff: I like an outside party to add input into this, maybe into the discussion and the collegiality thing, rather than to the change process. Maybe the change but may be that is the wrong spot. The change process comes about through ourselves. That's a really internalized thing. Gary's input is into the discussion and the collegiality as an external thing.

?: Hm, ya.

Geoff: Another input into that. So that leads to change. Changes leads to alternative programming from ourselves and alternative practices. The
change, before we go any alternative practice, this feedback lead into the
discussion, will that be correct?
Craig: Yes.
Geoff: All right. So if we can scratch it on the back of this and see if this is
what you think. At the top, we've got basically three inputs into the
discussion process. We've got one, our interview; two, student tapes, critical;
three, so they're inputting into discussion and collegiality; three, we've got
the external facilitator/resource base, is that right, which is Gary. This leads to
change and then going back to discussion we have a formal and informal
feedback. We have might have gone into informal feedback, haven't we?
David: Hmm.
Geoff: We also got, where does the time thing come in into this. Time and
change and from that, from the change process, comes alternative programs.
I think assessment can come under practice because it's probably a teaching
practice. That's a much simpler thing, I quite like it.
Appendix N-Instructions for Individual Models and Personal Statements

To: Geoff Hastings, Science Head Teacher, Oberon High School
   011-61-63-362164

From: Garry Hoban, Faculty of Education, UBC, Canada
Fax: 0011-1-604-8229222
Address: 2501 Melfa Lane, Vancouver BC, V6T 2C5, CANADA

Dear Geoff, Craig and David

I suppose you are sick of me by now and I don’t blame you. I am in the process of writing my thesis and I would like you to do one more thing for me which is really important (I know I said last time!). The main argument in my thesis is that our professional development program works for your teacher learning. The big question is how! In other words is there a model here for teacher learning?

So the crux of my thesis is what you guys think is the model that represents the process of your own learning. That is why these diagrams are so important. So basically what I want you to do is to explain your own model and I will put your diagram and your explanation in my thesis (this is much better than me saying what I think you think). Also I know that the program is more than the student tapes so talk about anything important to you. So could you do the following things please:

INDIVIDUALLY
1. Think of something concrete that you learned and changed in your teaching because of the program. Think about the aspects that contributed to your learning.

   Sketch a diagram showing the relationship between these aspects (use the same diagram if you wish or change it).

3. Number the important parts of the model (this is essential so that someone can follow your explanations)

4. Tape record your explanation individually explaining the words you use being as specific as possible (e.g. name the part of what tape, what you thought, what you tried but keep referring to the number and what you mean by the word so that a reader can follow it)

5. Can you think of another example of something that you learned—is it a different process? How is this different or does your diagram represent a similar process?

GROUP
6. Can you agree on a group diagram (use the same one again if you wish). Can you do the same thing again, number the different parts and explain each key part as a group.

Please make a copy of the tape and send the diagrams with the tape over to me. Thanks heaps guys—I owe you a few beers at the ox.

PS Oh yes, there is one more. In my thesis I am writing a chapter on each of you to pull this all together. When I finish it I would like you to read this to comment on my interpretation.
PSS For David—this is an optional request but could you also sketch of me what you think is a model for student learning (I already have one from Geoff and David).
Appendix N-Teacher's Personal Statements
Explaining their Model of Learning

David's Personal Statement Describing a Model of his own Learning

1. Personal Reflection
This is the model. First of all, how students learn science are talking about how what I'm teaching has changed due to the professional development that we've done. I think there are a number of factors that contributed to it. First of all, as I listen to the tapes on how they learned, I think that really started me thinking and started me sort of summarizing and reflecting in my own mind about a number of different things. It started me thinking why do I teach the way that I do. In other words, when I plan a lesson, why do I teach it a particular way? In not only planning lessons but in things like classroom management as well. It has sort of wider implications. It prompted me to really think about how I learned. I've never really thought about that before in concrete terms, how I actually learned to do something. And so I think that's been really valuable to look at our learning and that I learn in very similar ways to the kids—they learn in different styles. Before I would have just said it was from reading or whatever or talking or something like that, it's much deeper than that. I thought about how students in my classroom learning, and as you know I know there are a lot of different learning styles and kids learn in many different ways. And I think it's really important, as we talked about it many times before, to have a classroom that caters for as many learning styles as possible. And the last thing, not the last thing but another thing that it's taught me to think about is what has actually mean to teach science? What is science and what should I be teaching? Science is a very broad subject, you can almost teach anything you really want to, to fit it into the curriculum type of thing. And I thought about what am I teaching in my classroom that the kids that I have are taking away with them, and what use are they making of it? I think that's a really important thing to think about—what are they actually learning, what are they benefiting from being in my classroom?

2. Social—Group Discussions
I see the central part of the program as being the discussion and the support of the colleagues, of Craig and Geoff in particular. I feel that without their sort of enthusiasm, I don't think it would have been quite as effective. Not only enthusiasm, but just knowing that there's someone else having the same sort of difficulties that I was having in terms of changing what I was doing. I look back now, like when I'm planning a lesson I sort of go through all these different things, it's funny how that sort of triggers in your mind. But I don't think I would do that as effectively anyway on my own, knowing that we as a sort of a faculty have a type of a goal, or at least had a goal, I think we have accomplished most of those or some parts maybe we need to work on, to change our teaching. I think it's been a very effective thing. And I think also
the students say that too. The students I think see the science department as doing things differently from others. And that I think it comes from sort of the collegiality between us if that's the word, I think it is. So from the sort of the discussions and also you can bounce ideas off each other, “Hey I am thinking of trying this, do you have any ideas that we could build on it?” That sort of comes up every now and again, “I'm thinking about this topic, how did you do blah, blah, blah?” So that’s really good.

3. Individual—Reflection and Experimentation
But from the colleagues, discussion and the sort of support and mateship sort of thing comes the personal side of it. There is a personal side and it's sort of the reflection on, if it's not every lesson, then certainly every few lessons or even every topic, sort of an evaluation. How effective was it? Can I improve it? What are some ways of doing it next time that might be more beneficial? Do I need to reteach something that didn't work very well? Then you've got to give those sort of ideas a go, reflect on those ideas, did they work? No, modify it again, did it work? No, okay, chuck it out, forget it, don't do it again. And if you can modify it, yes, just try it and see what happens and go through this process of trying it, reflecting on it, evaluating it, I guess reflection is another word for evaluation. See if it works and if it does, great, if it doesn't chuck it out.

4. Social—faculty development
I think there's another side of it though, as well as the personal sort of side. This is what I'm sort of getting at a minute ago talking about the colleagues. I think it's more than just changing your teaching in a classroom. You have to do more in terms of changing the actual programs, the things that we teach, the structure of the programs, and also I think lastly, assessment. All these things I know you realize, but I didn't before. I didn't realize that we needed to look at what an impact programming can have. And I personally think, and I don't know if the others share this, but talking about our programs, I personally think we can do more with our programs. I think that we need to look at exactly at what we are teaching and try to give the kids options and electives within subjects. I think can we do this particularly in terms of years 9 and 10. I think we can sort of refine them more and actually say to kids "You could do forensic science, you could do a topic on consumer science, or you could do a topic on organic chemistry, or whatever the case may be, instead of just looking at sort of topics that aren't related to the outside world. I think we can do more in that sort of way. As I was saying a while ago, getting back to the colleagues, changing that—the way the programs are structured is a staff thing, it's a faculty thing. I think without the faculty support, it will be much more difficult to do that. The same thing applies to assessment. I think its really important that as a faculty we change that, not just an individual teacher. Basically, the support, the ideas, the collegiality as a whole thing, I think it would be really difficult on your own to do that. So I think that's sort of the way that it's changed my teaching.
Example

I'm going now to talk about a topic, let's choose a subject. I think I'll probably do Astronomy 7. Start off with year 7. Looking at astronomy, I know I have taught in the past very structured, a worksheet sort of model. I know I did last year you get the kids to make, as a class, to make a model of the planets and spaced them, made them in sort of relative sizes and spaced relatively in the classroom. So I got a big sort of group of planets to do and so forth. Well, it worked reasonably well. This year we got to do something completely different. I've given the kids an option, gave them a sheet and they could choose any particular area that they liked. So one group has chosen stars, another group has chosen planets, another group has chosen famous astronomers and so on and so forth. Those students then have gone away and they grouped, there's one group of one or twos or threes and I let them choose their own groups. They've gone away and they've researched that and they're now at the stage where they're presenting their research to the class and they actually teach in class. I've got them to do a number of things. Some of them are doing overheads, a couple of groups are doing skits and role plays, another group is doing a worksheet approach. They're doing quizzes or any combination of the above. Each group is doing about 50 minute period each on their particular topic and they teach it for us. So far I've had three presentations and I'm really impressed with them. Although they vary a little bit in quality, I think the idea of giving the kids experience in doing that I think is really good. I think they're benefiting from it. I think they're really learning from it. After that I'll go back on things that are missed out, I'll give them kind of like a sheet with points on them and I've got a complete task with a value of 15 points so some have marked it one point and others have taken longer or whatever and marked it 3 points so that it can _ to a value of 15 points or something. I haven't quite worked that out yet. I kind of like many of these things, picture card approach to other things, something like that. And then anything that I feel is loose end after then I'll just tidy up myself. One thing I'm finding is it's taking it a lot longer to teach it this way. It's taken weeks and weeks and weeks, but I think the kids are really learning from it. And I think it's a very beneficial way of teaching. The classroom is chaotic, particularly with the year 7, _ are rowdy. And a couple of them they really did no task so that gets me really flat out. Sometimes I sort of oh, why do I bother teach this way. And then you sort of say no, look at that group, they're working fantastically, they're really learning. They're doing it their own way. Some of them really kind of set it and you know, doing skits and stuff like that. Others prefer the _ sort of research worksheet presentation, questions, that sort of stuff. There's quite a few in the middle, who are making models or diagrams or whatever. They're doing a combination of things, too, in their groups. So I'm really pleased with that rule. I'm not just sure how long this tape has got to go... But anyway, I think that's described what you want me to do. Hopefully in the future you'll be able to come over and come back the next year and look at
what we're doing. I think it will be good for you to sort of see because you only did a couple of observations before and ought to come back and do a couple of observations now and enable you to see exactly the changes going on. Maybe you could give us some feedback, too, on what you think, whether this is beneficial or not? It's most beneficial - in what way. I mean I do know, but it might be good to have an outsider's input into that, to talk to some kids and get their ideas on it as well. So now Gary, good luck, and I guess we'd catch up within the future. See ya.
APPENDIX N
Craig's Personal Statement Describing a Model of his own Learning

Before we start, I've altered my diagram slightly. It's basically the same idea, except I think I put it on paper better. I wasn't very happy with the way that I had the other one on paper so I've tried to make it a little bit easier to follow because I don't think the original diagram explained exactly what I meant very well. So you'll get a new copy of my diagram with the tape. Just going with the diagram, I've numbered it from one to ten, I'll it might be easier to follow for someone who is going to read it.

Individual reflection
On point one I have my original ideas, they're the ideas that I came into the program with, before I've listened to the kids' tapes, before I've spoken to you or Geoff and Dave a bit. Point two is the students' thoughts from the tapes that we listened to. And I think that was probably one of the most profound parts of the whole program, for me anyway. It was sort of the crux to the whole thing, without the students tapes, basically I don't think it will work very well. Three is me listening to the tapes. After we listened to the tapes, we get to point 4, this is where I assessed my thought against what the students thought. In some ways they were parallels, in some ways there were vast differences, particularly in the aspects of practicals. My thoughts on writing and so on mirrored somewhat by the kids, but my practical ideas were in some ways vastly different. I've changed the way in which I do practicals. Instead of a lot of short practicals with definite end points, I've now introduced a larger number of longer practicals with less definite end points to which the students have to find an answer. But I've also at the same time, tried vigorously to instill in the kids that right and wrong in determining an outcome from an activity means if they don't get to the end point, it doesn't really matter. So I suppose in some ways failing is okay, but I don't use the word failing, I don't like that much. I prefer to tell the kids if you don't get to the outcome or what they think they should get first off, then that's just bad luck, then they got to think of another way of doing the whole process over again to enable for them to get to the outcome. So with success and failure, they find some way of getting to what they think they should as an answer even if it takes them several times. As I've spoken to you and said on other tapes that time is the enemy, I believe, of this type of teaching. And if you constrain yourself to time, as each topic has taken six weeks or four weeks, I don't think it will be very successful because you won't be able to extend the kids' out in such a way that they can try and fail, try and fail, even though I don't like the word fail. The time is the evil enemy here. Anyway, as I assessed my thoughts against the students, I changed it mostly in practicals.

Individual Experimentation
Now is my opportunity to try and implement what I believe I learnt from the students, and this is an evolving process and it's taken a few go's, and a few
failures and a few successes. And from the diagram you go from point five to point six where I've sort of indicate there is a good and okay and not successful outcome from what I originally wanted to do. But in the end it doesn't matter whether it's good, okay, or not successful, I generally get to the same point because after each like good, okay, or not successful, I assessed or reassessed why it was good, why it was just okay or why it was a bit of a dud. And reassessing, it gave me some idea of why, why it was good, why it was okay or why it was a a dud. But I've got all these things going to one box 8, called improvements. And I don't think, it doesn't matter whether you've done a good job, an okay job, or not successful job, there's always room for improvement because even when you're successful, practicals or successful lessons or topics or whatever, somewhere down the track even though you might think about it, you'd probably find something to improve it. So it's a never-ending or evolving process. So it's like a cycle with no end point. So there's always improvement no matter how well it's gone. And as each group is different from year to year, you're going to find some things are good some years and not good in other years. And you must really look at that and re-assess that and ask yourself why? Now I think as time goes by, you'll probably become more competent about the assessment type process. You'll be able to look at a group of students that you've had for a while and be able to sort of assess the way you should go with the lesson better and, therefore, have more successful or more productive and a large number of successes. And in some ways, I think, that's already happened. I tend to look at my groups of students now and so this group X or Y think about the kids who spoke on the tapes and try to sort of look at how many of those types of kids you have in the class and hopefully sort of gauge from that what the class will be thinking or probably will do with a certain activity. And that will enable me to direct it in a certain way and hopefully be more successful than just going in there and doing it and try to work at what went wrong later. It's like a cure is better, oh sorry, prevention is better than the cure. If you can go in there before, to think about it and have more ideas about what you think could happen, then I think you'll have more successes than just doing it, looking at why it didn't work, and hopefully doing it next time and it will work next time because that might not happen because the group that comes along next time will be different. But if you can assess each group before you do it, then the numbers of successes in the future will be greater and, therefore, the reassessment at the end may be less important, not not important, but may be less important because you had more successes.

Social
If I am struggling to find an improvement, particularly on a topic that I might not have a great deal of background in, then I'll look towards David and Geoff. If this would happen in the case of say astronomy or something, I would definitely go and speak to Geoffrey. And if it was something to do with biology or ecology I'll definitely speak with Dave. They may give me a better insight into how to improve what I'm doing. So they are very
important aspects of thinking about what I'm doing. If you don't talk to
colleagues to try and improve what you're doing, then you'll sit in a hole and
never go anywhere. So you've got to be confident enough to speak to them. I
think that's very important and that's point 9. But you'll notice it from box
no. 8 and box no. 9, they meet at a point and they end up going back to no. 5 to
try again. Even if it's good and works fantastic, and you can think of an
improvement, well go and try it. If it doesn't work, then you go through
whole process again. Why didn't the improvement that you thought was
going to improve it, why didn't it work? Should I just let it as before. Was it
really an improvement or not? So then at the bottom of 10, I've got no end
point. It's a continually evolving process like a cycle because no group is the
same. And you have to continually reassess and re-evaluate your successes
and failures. I don't think you ever ever get to a final point where you know
everything. Just as kids change, your ideas will have to change along with
them. So it's a continually evolving process.

Garry's role
Okay, just a few points besides the information on my diagram, I've got the
program and the learning that I've sort of been through myself. I think that
the basis, as I said right at the beginning of the program, was the tapes and the
kids to give you a better insight into how their minds work and then parallel
in the differences between what they're thinking and what I'm thinking.
Without the tapes there would have been no way of developing an
understanding of it because the students wouldn't come to you with that
information. If you ask them about it, you would not have got what I believe
to be an accurate idea of what they're actually thinking. Therefore, I think,
after the tapes, it was very important to have someone external provide the
kind of information. And I think your role Gary was extremely important.
In some ways, I was a bit disappointed that you're sort of not as accessible in
the latter stages of the program as compared to the beginning. It was as the
person that came in and talked to us about it, you're someone that we could
speak to and tell about what we had achieved. It's alright David, Geoffrey and
I speaking about, talking to someone sort of outside our little trio, bouncing
things off and you actually ask me to ask questions which, in some ways, you
ask us questions that I may not have asked myself. It helped generate
thinking and enabled us, or me anyway, to get my ideas out to someone and
discuss them with someone sort of external from the three of us working in
the school. So I think that your role in this was extremely important. In
many ways, I'll be very glad when you come back from Canada because you
coming into the school and talking to us, I think, was very great benefit.

Example
I think thinking about what we've been doing or have done, I've sort of
changed, not necessarily changed my ideas and what kids should be learning
and stuff like that, but I've pushed away from one end of the spectrum
towards the other and by that. I mean I've always been keen on skills and
stuff rather than big on content but going through this process, I now believe that even more strongly and I'm not really keen on highly content type programs at all, and would rather see the kids develop lots and lots of skills. And I try to do that with my year 8 class this year. I had year 8 last year and a lot of this stuff I tried on first off. It just so happens that I'm having 7 this year and I got another year 8 class. So I've been trying a lot of this stuff on year 8 again and with the metals topic or just been doing or in the process of doing now, still doing mining stuff in the traditional way and just sitting them down doing library research then finding out specifically about something I've told them to do. We're still sort of researching and stuff like that but I've left it very open and let them sort of get out and find out information. Many of them have been going to the public library, getting information from the Sydney Morning Herald, ringing up mining companies and places where they mine particular metals. Many made phone calls. It's gonna cost $300. But in the long while it's important because even the skills of ringing up on the phone and talking to someone and asking for information, finding out where people are, how to get hold of phone numbers, are all very important skills. As I found out with these year 8 kids, their skills in that respect was extremely poor. So many of them have made the phone calls and spoken to people in Melbourne and Sydney and _____ and ____. They never ever had spoken about topics. So even if they come out of the course and not knowing where Brackenhill? is or what they mine at Brackenhill, which I hope they do, hopefully they would have gained sort of skills through communication - phone calls, writing letters and so on like that which really and truly will be far more important for them in the future than knowing lead, and zinc, and silver at Brackenhill or copper. We've also done that by, I produced a large board game. It's really hard to describe this, but it's a very large organ. I drew a map of Australia on some paper and its about 3 or 4 m. by 3 or 5 m by three or four meters. And they had to pick a state and go in that state and get information on different mines and stuff. And they may not remember how many mines in Queensland and in Australia. But the whole point of this is to show them there are other mines in Australia, to give them some idea what they mine and the importance of it. So all these skills stuff, finding a way something isn't transferring from a small of Australia on to a large of Australia which is larger and try to get this and judging where things should be. All these things I think are far more important than the content. And all through this process that we've done in the last two years I believe that more strongly now and I'm in favor far less of content than I was before. In the recent quality assurance visit by the department, I discussed this with one of the department fellows. But obviously at the present time, the state government is not because they're pushing for more content and really and truly from what. So that idea from mine, of the skills and stuff, is more strongly than when it was before. And I'd rather have more open learning, where kids go off and do research on particular topics and research things that they are interested in that topic, rather than set them a definite set of outcomes to achieve. There may be
some things that I see is important to them that might help them in the future when they're trying to research some topics. There are some background information that they may need to know no matter what they're trying to research and you'll never get away from it. I think that's very important. But in general with the topic, I think, the majority of the topics should be spent by them researching and deciding what they want to do and going at doing it.

Year 7

(END OF SIDE A). If they take to do this, there's always going to be problems because the younger the students, the longer it takes them to organize, longer it takes them to find information, and are less competent. They have less idea of where to find the stuff. So you've got to help them continually, not tell them, but help them. Same with the phone calls and stuff. I didn't make too many phone calls. I might have helped them follow the numbers and suggest places to ring, but I left it up to them to ring it. For many of them it was a first time experience. Some of them bungled it up, but in the long run I think it will do them good. And really and truly I think that's the way I prefer to go in my teaching. It's less structured which is in some ways puts it in the basket of disorganized some times. It does look disorganized at times. If you keep running like blie from one place to another, it's going to be disorganized. You have to be sort of rely on the goodwill of the kids to do the right thing. Now if after attempts, after attempts, after attempts, they keep trying but I don't mind if they can't do it, as long as they're trying. If they're just going to bungle all the time, then you've got to think of something to do. And that's another sort of thing we can sit here and talk about, but generally you hold them on their goodwill to do the right thing. And generally the kids we've got, 90% of them will do the right thing which enables you to sit down for periods with those small percentage who find it very difficult to please for various reasons, from not being able to cope with the reading and the writing skills. Largely just might be attention seekers and pains in the bum. There has been implications on reading and writing because when you let them go off and research and stuff, then they do the reading and writing skills. So you tend to spend a little bit less time than you maybe would like with the really good readers and writers and competent researchers, which in some ways is not a bad thing. And then you get to spend more time with those that are having problems. And actually that's a good thing. Like you spend even amounts of time with everybody, practically that's impossible. If you can let the good researchers go off for themselves and talk to them maybe at short intervals or when the bell rings you can talk to them for five minutes until their next lesson. You have a good talk with them then. Then you spend a lot more time with those who are having trouble and help them develop their skills. I think that's, in this whole program that's one of my main changes apart from and how I do practs.
Subject matter
The ideas of what they should be doing as the program has changed, and I've become pushed more towards the self-learning and less structure in the content than what I was before. That has very big implications for assessment which we are grappling with at the present time. This was brought up at one our inservice days with the three of us will initiate. The progress so far with all our ideas with what's going on, but our assessment has been lagging. Because even though our ideas are changing, the assessment is still based on a lot of content stuff. In all I don’t think the two match very well. Geoffrey has been very good. He's been looking around for different assessment of things with the help of Wendy, who has access to lots more stuff. And we grappling with that at the moment. I think next year, that will be our main goal to try and revamp the assessment system to make it more relevant to what we have been doing. If we can do that, I think that in itself will be another major achievement and a very important one based on the material that we've been doing at the present time. The end of the page you've got an optional request, sketch me what you think of the model of student learning.

Student learning
Well, I may have to think about that one and I found it to be a tad difficult because I don't know whether you can sort of quantify how students learn in the one sort of sketch or theory because of the vast numbers of different students and the different ways they do things. Even two students that I have in the year 8 class who have developed very good research skills and are extremely good researchers. Even though they're doing the same thing and have all these great skills, they tend to do things slightly differently. But I'm going to give it a go. I don't know how well its going to come out. Well, we'll see what happens. And that's about it. I hope I've sort of answered all your questions. If I haven't, please give Geoffrey a bell?
APPENDIX N

Geoff's Personal Statement Describing a Model of his own Learning

I'm sitting here on a Sunday afternoon with a beer and I've prepared some notes about this. So hopefully it won't sound too shocking. Now, starting off, you wanted me to produce an example. A little bit about this. I really could have taken any one but I think I'll take the astronomy topic that I'm doing at the moment with year 7. Now I'll start off talking about how I did it or used to teach astronomy and then go on to now because I think actually my astronomy teaching wasn't too bad, but anyway.

Example of classroom teaching
Originally when I taught astronomy, they are set out in deliberate sequence and the sequence came from me. And what I did I had in my own mind was that the sequence would start from the history of astronomy and from the earth and then build out from the solar system into the universe and try and show a structure. Now, for most parts, the way we would have done it, we would have had some individual assignments and things like that, but mostly we would have gone from one part to the other and we would have had notes and audio-visual and all that sort of thing. The notes I would have given them from the board, from overheads, that sort of thing. At the end of the six weeks or whatever it was, we would have a test, and every one of the kids in the class would have had exactly the same experience. Now, I'm doing it slightly differently.

Programs
One of the ways that this has affected us is we've actually looked at our programs and we've made our programs centre about a core of outcomes which are actually knowledge outcomes, not nearly as many, I wouldn't have expected, no, I'll say it again. The core is much smaller than in the past that I would have expected students to learn. I think it's well that doesn't come out, it sounds like I'm compromising but it's really. All right, I want to make sure that all the students have the same core experiences in our topics in year 7, that core of knowledge is centred around the earth. So the way I've done it now, each of the students to specialize in one area. Some of them did eclipses, some of them did tides, some of them did the phase of the moon, some of them did the seasons, the lower ability kids did day and night. They each had to present a little play where they themselves became part, became a planet or so on, and then they presented that to the rest of the class. And the rest of the class had to ask questions about it and then I questioned them. And the other thing that the rest of the class had to do was they had to make up little diagrams and notes for themselves about what the students learned. From there then, we went on, the rest of it were very much into, well as the syllabus says, behavioral things and skills-based stuff. And what we've done
is we have a list of things that they can do and each of them is going to be worth so many points, depending on the degree of the difficulty, and they have to make up 15 points and present a thing. And they can select anything they like to make up the 15 points. If it’s not on the sheet, I’ll give them a sheet of experiences that they can try and do on their own. What we’re talking about here is things like build a telescope, present a project on the nine planets, research one astronomer of the past and they’re worth different points. Anyway, I’ve thought a lot about the way they learn and then from there you’ve got to think a lot about assessment and what part it plays. And I’ve decided, because I think without the assessment you’re not going to get the excellence, and really testing doesn’t test for excellence. What testing does is sort of, it doesn’t test what you’ve done or what you’ve learned. So the kids are going to present this to a panel and the panel is going to include, if they’re available, their parents or another community member. Anyway, so this will be really interesting. And also some of their peers and we’re going to use that. They all get input into the final assessment. I’m pretty excited about that. Now the reason. Now where does this fit in with my diagram.

Personal reflection
Well, I will explain this now in terms of my diagram. When I look at my diagram, I think it just about puts it in, the thing that starts you off is the combination of listening to the students’ tapes and having the opportunity to reflect on your own performance and to sort of put down what you think about teaching onto tape. Now, all of that was really important because it’s like a starting point. It uses something to base what you’re doing on.

Social Interactions—Ideas of others
But then the important thing was that it continued on over time and all the time we were coming back to these, we kept going back to these inputs that came in. And then other things came in from the side, your input, your views, things like that, all taken on board. The collegiality, talking to the others, working towards a common purpose that encourages you because you tend to lose the plot of it in the day to day hurly burly It’s all important and the time to reflection and then the starting point of the student tapes and your own time for reflection, what happens then is you start to think about change and then I’ve put in a new addition—you take on board other ideas like we had like the SLAC day and things like that. And what you do is you incorporate that into the framework of what you’re thinking about.

Cycle of Change
And then what happens is you look at change and then you get the feedback and the only way you’ve got feedback at the moment is through informal feedback, from the students, how you yourself feel it’s going, from the collegiality again, from your colleagues talking it over and stuff. So the whole thing becomes sort of a closed cycle of change where you start with the student tapes and you start to reflect on the various aspects that you practice
and you bring in all these external influences and you bring them together and go ahead and try and work out what you're going to do yourself in a classroom. And the important thing about it is that, and this is where it's different to other forms of professional development, and this is why it's caused change, is that it continually is reinforced. Because it's ongoing and because it has this framework that we keep going back to, we feel as though we're part of a project and part of a process that's ongoing and not short term. It's not stick a finger in the dyke here, stick another finger in the dyke here, learn about literacy here, learn about assessment here—it's a whole integrated package. And I think, to a certain extent, we've integrated it ourselves because we've taken on board these ideas, but the basis of it is, is that skeleton, that starting point—the student tapes and your own opportunities for reflection, and then the change, feedback, more reflection, change, feedback, that cycle all the time bringing in ideas from outside, from other inputs, from your colleagues, from you and so on. And I think if any of these factors had been missing, then it wouldn't have worked. That's a personal view, I think if I did that one for the faculty, it would be different because I think that reflection cycle, I'd put another factor in there, and you need someone to keep driving the cycle forwards so that it doesn't reach a step and then stop and that step isn't missed. Say you get to the change part of the cycle and it goes to the informal feedback part of the cycle, and if there isn't arrangements done to make sure that happens by someone, then the whole thing collapses and you're finished, and you lose that continual circle of ideas and change and feedback that you really need. So it'll be interesting, I don't know if the others see it that way, but I do. What else? Just looking over the second part of my sheet. I'd say here the important part is to actually start reflecting—to start off, or for us to start reflecting on our teaching practice. Once that was started, that was a critical part, and the things that do that are the student tapes and our tapes, the fact that we sit down for three hours on tape and think about our teaching practice. That's the thing that starts it. And then it has a certain momentum of its own where you get feedback, and that's the important one, where that collegiality and your input is extremely important. I think that's all. So the only change that I've made so that it explain.

Individual influences
If I summarize now and explain my diagram, what I've got is I've got the student tapes and our own reflection on tape of this stuff, inputting into this, personalized feedback for reflection. That's a starting point, okay. I should write causes reflection there.

Change Process
And then you get internal, external input. You get input from you and from colleagues, the collegiality aspect, and I've put in a third one - external input. So that could be external courses, influences like I think talking to Wendy, that sort of thing, as an educator. That all goes back to into the reflection and it gives you some sort of a knowledge base, I guess a research base, to enact
change. You’ve got the motivation and you’ve started reflecting on your practicing and thought from the student tapes and your own reflections. So you’ve started the process that maybe there’s things that need to be done. And you take on board the ideas, then there’s change. You try out the change and then you get that feedback. Now, this is important. At the moment our structure is only for informal feedback, but I think it’s important that we have formal feedback so that we see what we’re doing right, what we’re doing wrong in terms of the kids, otherwise we abandon the whole situation where we’re trying to get feedback from the students. So I think that has to be built into our process, and that’s something I hope to do now over the next 12 months. I think the whole process, I’ve thought long and hard about this, we’ve been at it for two years, I think there’s another two years in it. I think it’s a four year project, no less. One year to start reflection and to start playing around and to get ideas, one year to really try out ideas, no, two years to try out ideas and also to incorporate that into your programming, and then a fourth year to really consolidate what you’re doing.

A couple of things. One of the important things, I still think one of the important things is the writing part of it. If you want students, I mean it comes down to students owning their own work. And I think I’ve got the writing part down pat or I will have next year when I start it fresh. But I’ll talk to you about that when you get back. And I just thought of something else that I wanted to say and now it’s gone completely out of my head. Anyway, I hope that explains my diagram.

**Summary**

But I’ll summarize again. The student tapes and the opportunity to reflect ourselves on tape are the things that start you off. And then you have the external inputs to give you this sort of, the external inputs to give you that research base to change, to change, and then you try to change and you get the informal feedback. This is where collegiality is important, too. And also your own professionalism and your own ability to reflect which has been sort of enhanced by the fact that you own this project anyway and also feedback from the students. And that leads on to looking at your practice again and being off to change and it becomes a cycle like that.

Okay, I hope that it helps you and I hope I haven’t bored you absolutely shitless. And the next voice you hear on this tape will probably be Craig’s and then after that the three of us. Thanks Garry.
APPENDIX O-Student Interview Guide

PURPOSE: The purpose of the interview is to find ways that help you to learn in science classes and ways that do not help you to learn in class. I am going to ask you some questions about things that you have learnt at school and then we might discuss ways that influenced this. Do you mind if I tape this? I will be collating these comments and playing them back to the teachers.

POINTERS
Don’t give my opinion
Wait Time
Probes: Can you give me an example?
What do you mean by this?
Why? How?

QUESTIONS
1. Rapport Question: Can you tell me about yourself?
2. Positive Context Question: Can you think of a concept or topic in science that you have been taught in the last two years that you really understood well so that you can clearly remember it? Can you think of anything that helped you to learn it so that you understood it?
3. Negative Context Question: Can you think of a concept or topic in science that you have been taught in the last two years that you did not understand? Can you think of anything that did not make it clear for you to learn so that you did not understand it? Can you think of anything that would have helped you to understand it better?
4. Alternative context question: What subject do you believe that you learn best in?
5. Role play question: Can you think of a topic in science that you understand well? I want you to pretend that you are a science teacher and you are trying to teach some children about this new topic. How would you go about teaching this to the students keeping in mind the things/ways that help you to learn?
6. Open question: Do you have any other general comments about ways that help you to learn?
7. Hermenutic/Dialectic Question: I am going to tell you some of the things that other students have told me which help them to learn. Could you give me your opinion on them?
Appendix P-Sample of Excerpts on Student Tapes

<table>
<thead>
<tr>
<th>Cambourne's Conditions of Learning as it applies to Literacy Learning</th>
<th>Ways that Help Students to Learn in Science from Secondary Students' Interviews</th>
<th>Summary of Ways that Help Students to Learn Science as Described by Students with some Typical Quotations</th>
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</thead>
<tbody>
<tr>
<td>Immersion</td>
<td>No student comments.</td>
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<tr>
<td>Demonstration</td>
<td>Demonstration</td>
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<tr>
<td>It helps some students to learn when they are shown what to do when they do not understand or know what to do:</td>
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<tr>
<td>&quot;If someone sits down and explains something to me or if the teacher is out the front and has, they do a practical first and show how it works. I find it better than getting up and trying it on my own. I find it easier.&quot;</td>
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<td>&quot;There would be five or six of us and he would sit there and explain things to us and he would go over and over it. The others didn't need to know that but we had to know why to understand otherwise it meant nothing.&quot;</td>
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<tr>
<td>&quot;If is something interesting it is a very different way to learn. Teachers are up there and saying this is what happens instead of saying this is what happens and writing it on the board, they are showing you.&quot;</td>
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<tr>
<td>Expectation</td>
<td>Expectation</td>
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<tr>
<td>It helps some students to learn when they are given a goal so that they know where they are heading:</td>
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<tr>
<td>&quot;I like it when he says 'You have to find out about how to do this.' Then you go away and do a few experiments and do a bit of reading up and I think you learn a lot better that way especially when you are with a friend and discuss it with each other and then the teacher will come along and ask a few questions about how you are going, he will come around and listens to what you said and he will give a definition back to him and he will explain it to you.&quot;</td>
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<tr>
<td>Responsibility</td>
<td>Autonomy</td>
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<td>It helps some students to learn when they play around with their own ideas rather than be given instructions from a book or the teacher:</td>
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<td>&quot;When you are taught about metals or the skeleton, it’s fact and you can’t say it’s not. Whereas if you can discuss something to have you own idea in theory on the subject that I think is much more enjoyable than just being, just learning straight information that you know can’t be argued or not argued; but discussion, I like talking about things that are have controversies surrounding them, not that much with any problem with them but they can be discussed and are not proven. Those things are easy to have your own ideas about them because with other things you just can’t have your own ideas about them. Because you can have your own ideas about it like I said. If you are given the instructions you just put it together but that can be interesting too. I certainly like doing it myself because you have a sense of discovering yourself, not so much just having been told it.&quot;</td>
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<td>&quot;We don’t get many questions, it is usually all their input into us, the basic facts and with experiments or practicals it really kills all the curiosity. They write down the main facts you need and then say ‘Go off and do this as a practical’ and it doesn’t really give anything to ask about unless you are really interested in the topic and you really want to know more and more. A lot of kids just don’t, if they don’t give them anything to want to learn about they just won’t ask and they won’t learn anything more.</td>
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<tr>
<td>Use</td>
<td>Practice</td>
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<td>It helps some students to learn when they try activities more than once to see if they can improve on the results:</td>
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<tr>
<td>&quot;We had to a certain amount for homework and when you do it at school too it is easy to remember things for the next day.&quot;</td>
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<tr>
<td>&quot;I like to make up my own experiments and do them until I get it right.&quot;</td>
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<tr>
<td>Discussion/Talking</td>
<td>It helps students to learn when they discuss ideas with teachers or their friends. In particular their peers talk differently from teachers:</td>
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<td>&quot;When we have our science afternoon we talk a lot to our friends. I like relating to other people and by talking to them and them telling you what they are doing, you get an idea of what you can do and you just add things to it of your ideas and you can come up with something that is better than what you were thinking of.&quot;</td>
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<td></td>
<td>&quot;Oh yes very much so especially with your other class mates. Because they can sit down and say &quot;Look I just don't understand it&quot;, and if you explain it to them, then its like saying in your head &quot;Well you get&quot; and if you can explain it you have to understand it. And by listening him do it over and over again and if one person doesn't get it the way he has explained it at first, he explains it another way or he will explain it over and over again doing different examples until you understand really well.&quot;</td>
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<thead>
<tr>
<th>Writing</th>
<th>It helps some students to learn when they write things in their own words rather than copying from the board or from a book:</th>
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<tbody>
<tr>
<td></td>
<td>&quot;I get all my notes before a test and type them on the computer. I can memorise my notes better by typing them rather than just reading. It is the best thing to help me learn, going through and retyping my notes on a computer, I do all my diagrams on the computer. I read a sentence out and memorise it in my head and then type it out.&quot;</td>
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<td></td>
<td>&quot;Most of time when you copy from the board you do not think about what you are writing.&quot;</td>
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<td></td>
<td>&quot;I prefer writing things in my own words when I have some idea.&quot;</td>
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<td></td>
<td>I like writing in my own words because it is just learning another way again. I mean instead of his way of learning you can look back and say that is my way of learning and that is my words and by your own words you understand better.</td>
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<td></td>
<td>If is all just writing and not much practical, it has to be pretty balanced because some kids learn better from the writing and some people learn better from the experiments. If it is all just one and not the other it tends to be no one really learns that good cause either way every one needs a balance.</td>
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<tr>
<th>Reading</th>
<th>It helps some students to learn when they read ideas and put them into their own words:</th>
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<td></td>
<td>&quot;Writing off the board and reading books help me. I asked him if I could actually have a book so it would be easier for me to do and I went through the book and that was the only way I knew how to do it. I went through the book myself and I found the answers that was it, that is why I knew about it.&quot;</td>
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<tr>
<th>Practicals</th>
<th>It helps some students to learn when they do science practicals:</th>
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<tbody>
<tr>
<td></td>
<td>&quot;Practical help you to learn because they get you away from the desk and the board. It helps students to learn when they are given the opportunity to learn from their mistakes.&quot;</td>
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<td></td>
<td>&quot;I hate practicals, I don’t find it fun running around with a group of people trying to find bits and pieces to stick together just to do something that you have previously learnt anyway and discussed. And you don’t really see the results that clearly because classroom experiments rarely work and it becomes hazy.&quot;</td>
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<tr>
<th>Reflection/Interpretation</th>
<th>It helps students to learn when they rethink and interpret what they have learnt to make their own connections and meaning:</th>
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<td></td>
<td>&quot;By asking more questions, the better we understood in our own way. I can interpret it in my own way and ask the teacher 'in other words you mean this?' and he would say 'yes, that is exactly what I mean.'&quot;</td>
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<td></td>
<td>&quot;We could watch and make our own, and again make our our explanations and figure out why it worked ourselves and turn it around in our head until we understood our own way. So its like teaching ourselves.&quot;</td>
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<td></td>
<td>The teacher asks &quot;if anyone has any questions at all, any questions at all?&quot; and we will have a big discussion at the ends&quot; as to what we learnt that day and what happened during the lesson...It is real helpful because you can reflect back on what you did in the lesson and you can remember it all and if there is something that just doesn’t fit you can’t work out or you can ask and it is explained again and then you understand again and also, if you ask your friends, a lot of questions you think everyone will know that and every one will go &quot;Ohhhhh, geez what is wrong with him?&quot; A lot of the friends ask the same question and that helps too and you find out about questions that you weren't really game enough to ask.&quot;</td>
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<td></td>
<td>&quot;I think that it is easier to understand something that you have interpreted in your own words because what the book says is expanded into something harder and you just break it down into your own words.&quot;</td>
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<tr>
<td>Approximation</td>
<td>Trial &amp; Error</td>
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<td>It helps some students to learn when they have the opportunity to make mistakes and learn from them:</td>
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<td>&quot;It's good to use your imagination and work it our yourself and nothing is really wrong, like you might not get what you are trying to achieve but you just try again and keep going until you get it right.&quot;</td>
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<td>&quot;Teachers should let us experiment first. You have to learn from your own mistakes. If you make something and it doesn't work and then you try it a different way and it that still doesn't work again, you sort of learn from it because you have to work out why that wasn't working then you have to solve it and see how can I fix that. Once you fix it then you try it again and if it works you know that you have done the right thing and then later on you remember 'how come that didn't work?' and then you remember when you made the mistake and you remember how you fixed it and you remember why it worked. A lot of practicals are enjoyable, some of the reactions and results, they are good. In an experiment it would be alright to say 'Alright here is the problem and try to solve it' and then make the experiment to solve the problem and you can try it but if it doesn't work then doesn't matter, you just learn it anyway... Yeah I like making up my own experiments, it is fun sometimes but if you don't understand it or you don't know how it works it is really hard but if you understand it and you know how it works it is good. You can make up all sorts of different ways to work it.&quot;</td>
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<table>
<thead>
<tr>
<th>Response</th>
<th>Response/Feedback</th>
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<tbody>
<tr>
<td>It helps some students to learn when they get help from the teacher when they don't understand or their experiments don't work:</td>
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<tr>
<td>&quot;The teacher really helped me to learn by telling me things as I went along like about different parts of a cave and how they were formed and so on. I went and did some research myself before I started to build the cave but during the building of the cave I reckoned I learnt more just from the teacher telling me things about what I was building rather than what I had just read from the encyclopedia.&quot;</td>
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<tr>
<td>&quot;If they ask you for what you think about it and then they can tell you whether it is wrong or right or what is really good whatever rather than them just writing lots and lots of notes. &quot;The best way for me to learn is through discussion and the teacher asking the students questions and sparking their curiosity and getting them to give some feedback through discussion and talk about it and that is the best way to learn.&quot;</td>
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<table>
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<tr>
<th>Engagement</th>
<th>Interest/Enjoyment</th>
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<tr>
<td>It helps some students to learn when they have fun and teachers enjoy themselves in the lesson:</td>
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<tr>
<td>&quot;I learn best when I am interested in what I am learning. Parents play a major role. If your parents are interested in something you will have it around you when you are young so you become interested in it.&quot;</td>
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<td>&quot;It has a lot to do with teachers trying to keep the lesson interesting and not the same sort of thing every day and doing stuff straight out of the textbook and straight off the board. It helps students to learn when they like the teacher and they respect the teacher. Students like to be respected too! &quot;If you don't respect your teacher you can't expect to get anything from them and the discussions always started that way and after a while we would go off on our own and discuss. We don't need him to stand there and help us anymore. It would be like teaching each other. I guess that the good old stereotype 'Teachers are terrible'. You don't like them, they're there to annoy you and stop your social life and stop you from playing with your mates or playing your tape in class or throwing around paper or whatever and by discussing it with your own mates and by being able to respect your teacher it makes things ten times easier. It is like sitting in class with your own friends and another friend who just happens to be a couple of years older than who is on your level and treats you with respect so you can respect them back so it is much easier to learn that way. It is a much more relaxed environment than standing up in front of a board saying this is how you do this and that is how you do that now do it. By discussing it it brings respect from both sides.&quot;</td>
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<tr>
<th>Relationships</th>
<th>Prior Knowledge</th>
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<tr>
<td>It helps students to learn when they &quot;know where the teacher is coming from&quot;. If students know something about the subject from previous topics or from their own everyday experiences, they have a personal context and catch on quicker:</td>
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<tr>
<td>&quot;I can remember Astronomy really well because I did a course at Mitchell College once for two days and I am really interested in that...I have been interested in astronomy since I was little because my uncle has got a telescope and we look through that and it was a fun topic.&quot;</td>
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<tr>
<td>&quot;I really, really got interested and enjoyed the topic of Matter. That was really good. I understood everything and Cells was good as well. It seems natural and I could get it instead of all the Circuits and Transformers. That was a topic I found hard, electricity and those sorts of things...Well I looked at it and I could see where it (Matter) was coming from. I could look around and I could say &quot;Yes there are atoms in wood and there is this and that sort of everywhere&quot;.</td>
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Appendix Q-Teachers’ Responses to Interpretations in their Case Studies

DAVID’S RESPONSE

Garry, here are some comments regarding the professional development program. As I told you the other day, seeing the changes in my teaching in black and white is quite a shock. My teaching in the classroom and my philosophy of teaching have changed dramatically. Some of this is no doubt due to gaining further experience, but most of it has been due to the program we have been involved in. It has opened my eyes and encouraged me to reflect on how students learn and how I teach. My view, lining up these two sometimes opposing facts up, is what good teaching is all about.

I believe your interpretations were correct in that my views concerning students have changed over the life of the program. I think that in many ways I had preconceived ideas that I took into the classroom from my own teaching experiences and expectations. I believed that I was there to teach in my way and I expected the students to learn in that way. I now know that students have a huge variety of learning styles and ways of learning.

There is also far more for students to learn other than a content of facts and figures. As you have correctly summarized, this is a reflection of the way I was taught at school and hence, being basically the only way I knew, that was the approach I adopted. As far as I am concerned, and believe it more than ever now than when I was actually doing it, my Dip. Ed. was a complete waste of time. I thought that I learned a lot on prac[ticum], but it was in many ways more of the same as the teachers who were my mentors taught in a very structured and straightforward way. Thus, it did not broaden my horizons in terms of teaching and learning.

I am now more committed to trying to improve my classroom practice than before. I see learning or more correctly teaching as a constantly changing and evolving occupation that will never remain static. I believe that it is essential for teachers to experiment, to reflect, think, and constantly be imagining themselves as students in their own classroom. I think it is even more important to put yourself in the place of a student who learns in a very
different style to the one in which you learn. The result of this reflection can sometimes be pretty devastating and that is where the support and encouragement of a committed staff is essential for one to embark on the difficult practice of trying to improve and change one’s teaching. Without this collegial support, I believe the road to improvement is a long and lonely place with many potholes and soul destroying places.

Learning is so much an evolving process and there is so much more to learning than facts and figures. In fact I now believe that skills and values and attitudes are more important as they are more relevant to every student when they leave school as learning will be a lifelong process for most people. In some ways though our teaching is so structured, especially in years 11 and 12 to focus on content and knowledge that it is hard not to focus on it. Most teachers take the view that it is easier to teach and evaluate knowledge than it is to do the same for skills, values, and attitudes.

During the program I said that I originally taught the students what I think I thought they needed. In this instance I had a huge misconception, what right do I have to make those kinds of decisions? That is putting students into boxes and making them come out the other end exactly as I want them to, not necessarily how they want to. This was a dangerous assumption and has drastic implications in terms of the teaching that I did in my classroom.

The outside world is where we all have to live and I said that I wanted my teaching to be more related to the outside world. This again is an assumption as the outside world is constantly changing. How can I focus on the outside world when the students I am teaching will live in a very different world to the one that I am now living in. I think we can use examples from the outside world but it is more important for students to be able to look critically and evaluate what is happening in the outside world. It will be more important for them to be able to learn and adapt in a changing environment.

I previously had a notion that we could fit all of what teaching is into a nice comfortable linear model. I now know that this is not the case and that this was an incorrect assumption. Learning is complex and different for every person. My teaching needs to reflect that. I would describe the changes in my
own teaching over the past two and a half years as fast evolution. The fairly dramatic changes that have occurred are by and large due to this program. The student tapes were the initial starting point from where it prompted me to think about my teaching. The interviews with Garry helped to crystallize my thoughts and views on teaching. In some cases this wasn’t during the interview but at night or when I was mowing the lawn etc. Sometimes, something I said would come up and I would reflect on it. I now see reflection as one if not the most important things in changing one’s teaching. The ability to be self-critical and analyse oneself in relation to teaching is an important tool and one in which I believe we should be encouraging students to use also.

Being able to experiment and make mistakes is essential. This does, however, need to be done in a supportive and collegial environment. At Oberon High we are lucky to have that.

This professional development program has been the starting point. I now believe that evaluation, reflection, experimenting, listening etc. etc. are essential attributes of every teacher. I hope that I can continue to do all of these things and more in the future as this will be the best way of continuing to improve the teaching and learning which occurs in my classroom.
Garry, I believe you picked up on the thread of my ideas well and your interpretation of my change was quite accurate. The notion of "fun teaching" is very important to me, however, my idea of practice to deliver this has varied and you outlined this very well. The movement towards more open ended practice has been very relevant and comes through quite strongly in your thesis. This is pleasing.

The ideas of skills was strongly shown through your interpretation and the increase of emphasis I had in this came though clearly in your interpretation. Our work clearly indicates my belief on it's importance and also showed that I strengthened my views on this.

I believe that you captured my change in practice well. I knew I had changed, however, seeing it written out was interesting and was a confirmation of change for the better (hopefully).

The aspect of time was brought out and is still a question yet unanswered. My concerns were documented and the problem is still present. The whole process is a never ending one with students coming and going and hence groups changing. The dynamic nature of the process came through and accurately reflected my thoughts. Those dilemmas, time and re-assessment, were indications of the dynamic nature of the process i.e. a continual search for answers and it came through the thesis. I am very pleased with your interpretations.
GEOFF’S RESPONSE

I found after reading the chapter on me that you have given an excellent interpretation of my feelings and attitudes before, during and after the whole program. Of course I feel that I was a teacher who tried to do any given task to the best of my ability and who examined my practice critically, but I know that I was not a “reflective” teacher as I claimed in those first interviews.

Looking back it is obvious that I always had an ability to examine my practice but I had no knowledge base on which to work in my efforts to improve. In fact I was not reflective as I did not examine my practice and look at alternatives—rather, I changed my practice within the constraints of my own experiences and understanding of teaching and learning. The program gave me the motivation to look further, initially because of the power of the student interviews and the effect that had on my understanding of the effect I had on students’ work and learning. As a result my knowledge and understanding have expanded considerably and my practice has improved.

Your interpretation is pretty well spot on Garry. I could not disagree but one thing is missing that perhaps I did not mention. I often spoke I think about the fact that eventually there would come a time when a teacher may reach some “light at the end of the tunnel” where they would be masters of their own craft so to speak. I now know that this does not happen and that in fact practice must be continually looked at critically and reflectively and that students’ ideas and opinions must be part of that process. That is why a natural extension of this project is to develop a self-perpetuating system where the students comment on the good and bad aspects of the teaching as part of the ordinary curriculum. That is something for the very near future. The student tapes have a shelf-life for the teachers as they become irrelevant through the process of change and it is not something that can be repeated frequently. But I have some ideas and would be keen to hear of anyone who is attempting to do something similar.
So the question for me that arises is this—all this understanding of practice and learning was available to me before if I had looked hard enough, why didn’t I? The answer is in the process of this program I think—I was in control of my own development, it was long term and personal. Nevertheless, the collegial nature of the whole process and the power of the students’ opinions as a starting point is essential. The rest develops according to each individual.

Before this program started I had been talked at by experts and shown “how to” by others. I, like most teachers, resent this and am unlikely to be swayed to any great degree by it. If there is one thing I found out as a learner from this process—CHANGE AND LEARNING COMES FROM THE INDIVIDUAL, IT HAS TO BE ACTIVELY SORT OUT. IT CAN NEVER BE IMPOSED FROM THE OUTSIDE AND THIS IS PRECISELY THE REASON WHY PROFESSIONAL DEVELOPMENT AND DIP. ED. COURSES FAIL—THEY ARE STRUCTURED THE WRONG WAY.

Garry, your interpretations of my progress are accurate. Maybe the stuff I have written here is my attempt to summarize and articulate what it is has meant to me.
Writing in Science and Agriculture is designed to:

1) Allow students to communicate with others
2) Be used as a learning tool by the student.

Common Principles
1. Students learn best when they are allowed to express themselves using their own writing and language.
2. Students must be introduced to appropriate technical terms as judged by the teacher and in accordance with the stated outcomes of the program.
3. A limited number of essential points will need to be given to pupils through prepared notes. In this situation, the understanding of the pupils must be tested through alternative assessment methods.
4. It is impossible to check all students' writing at all times but a maximum number can be checked by teacher review during the lesson or by the encouragement of students to read their writing.
5. Teachers should value all attempts by students to express themselves so long as that attempt is appropriate to the level of the student's language development.
6. For assignments, the Faculty will place a large bias towards the completion of home assignments in original language. Plagiarism will lose marks.
7. Teachers will mark student's work as frequently as possible.
8. Teacher will develop the concept of student review of learning through writing e.g. summarising.
9. Teachers will encourage the use of different forms of written expression e.g. the technical report, descriptions, creative writing, poems, summaries etc.
YEAR 7 ASTRONOMY PORTFOLIO

In this topic you have the opportunity to choose areas that you would like to study. You must include in your Portfolio, enough topics from the list below to accumulate 15 points. The date on which the report is to be completed by the 7th November. Anyone who has not completed the work by that day will not be allowed to start the next topic on Chemistry.

You will be expected to present your portfolio to the a group of people on that day. With luck one of these people will be Mr Marshall.

Where do I Get Information?
Could I suggest that one of the best places may be the library. There will also be internet access working. For some you may have to ask different people such as the school’s science teachers. Some of the activities involve you working on your own.

IMPORTANT: IF YOU JUST TRY AND WORK AT SCHOOL THEN YOU WILL NOT FINISH BY THE DUE DATE. SOME WORK MUST BE COMPLETED AT HOME.

AT THE END YOU WILL BE GIVEN A GRADE - DISTINCTION CREDIT MASTERY OR INCOMPLETE.
IF YOU GET AN INCOMPLETE GRADE THEN YOU WILL HAVE TO TAKE AWAY YOUR PORTFOLIO AND DO SOME MORE WORK ON IT. YOU WILL THEN HAVE TO SUBMIT IT AGAIN.

HERE ARE THE AREAS FOLLOWING. IF YOU HAVE ANOTHER AREA OF ASTRONOMY THAT YOU WOULD LIKE TO PURSUE THEN SEE ME AND I WILL MAKE UP A POINT VALUE FOR IT
ASTRONOMY OUTCOMES

At the end of this topic you will be able to:-

a. Represent the structure of the solar system using a model or a diagram. This includes:-
   - the nine planets
   - the sun
   - the moons and the moons of other planets
   - the movement of each

b. List the names of the planets in order from the sun and be able to describe 2 distinguishing features of each

c. Demonstrate an understanding of the nature of comets, asteroids and meteors

d. Write down the meaning of a star, constellation, clusters, nebulae and galaxies

e. Represent the relative separation of the solar systems components on a relative scale

f. Represent the relative size of the solar systems components on an appropriate scale

g. Demonstrate and discuss the principles of day and night, the seasons and the tides.

h. Practice working in a group and cooperating with others to achieve goals

i. Experience negotiated learning

j. Become aware of the wide variety of learning styles and resources available to assist learning

k. Learn to be responsible for your own work and actions including the meeting of deadlines

l. Become confident in your own ability to tackle more difficult tasks and overcome problems
LEARNING LOG - ASTRONOMY

<table>
<thead>
<tr>
<th>What I Plan to Learn Today</th>
<th>How I Plan To Learn Today</th>
</tr>
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<tbody>
<tr>
<td>I plan to learn</td>
<td>On Internet: x</td>
</tr>
<tr>
<td>about the 9 planets</td>
<td></td>
</tr>
<tr>
<td>and a few facts</td>
<td>Off information</td>
</tr>
<tr>
<td>about each.</td>
<td>In books</td>
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</table>

What I Learnt Today

Mercury, Venus, Earth & Mars are rock planets. Jupiter, Neptune, Uranus & Saturn are gas planets. Pluto is a blob of ice.

How I Learnt Today

From books and reading

Why I Did or Didnt Learn Today

I enjoyed it was very exciting

What I learnt today

That in 5 billion years the Sun will run out of hydrogen in the middle. The outer layers will cool and redden (after it exploded). It will be so hot that it will fry everything on earth and be destroyed then the sun will collapse into a small white ball as big as earth.
Appendix T-Science Faculty Junior Assessment Policy

OBERON HIGH SCHOOL

SCIENCE FACULTY

JUNIOR ASSESSMENT POLICY

1996

Background

Since our meeting in October when we discussed options for assessment that truly reflect what the students "know" and "learn" we have been trialling alternative strategies to our traditional numbers method of assessment. Issues that have been raised mainly revolve around how we could fit in with the school assessment practice.

We had general agreement that the assessment strategies should reflect our changed teaching practice and that we needed to make sure they revolved around the expected outcomes for the course.

We are thus in a transition period assessment needs to fit in with school expectations but we must use variety in assessment to truly "test" whether outcomes are being realised.

This includes the point brought forward by David that we have discovered that students are very different in the way that they learn and they are also different in the way that they can best show what they have learnt.

STRATEGIES

We have been trialling many strategies and have found that students must be given an opportunity to show what they can do and that assessment strategies must be varied.

Strategies to Use

1. Peer assessment
2. Use of Portfolios and student defence of their Portfolio
3. Test - written and oral - make sure the test reflects expected outcomes and student knowledge and understanding is explored.
4. Learning diaries - as the Learning Diary Develops this can become the major source of assessment - we agreed to take into account how they are analysing their learning in their writing.
5. Student self assessment - Once again the learning diaries are vital here - match the students assessment of their learning to your assessment of their learning - use this as the basis of a grade...
6. Student presentations of open ended and negotiated work.
7. Other strategies that you might add as we get better at this.

HOW TO USE IT

We will be expected to come up with a mark but this can be based on any combination of the above.

As an interim measure we have suggested that test form 15% - this means written
and oral tests and a variety of methods should be used for the rest - we will work on the basis that:
An A in any part is 85% plus and this means excellence.
A B means 75% plus and this is defined as being above satisfactory.
A C is satisfactory - outcomes are satisfied. The mark here is above 50%.
A D is minimal outcomes - some outcomes are not satisfied but they can be caught up at a later date in another area of work. 40% +
An E is unsatisfactory and outcomes have not been satisfied.

In our reporting we must show the areas of the course that the student has not satisfied and explain what they can do about it.
We must inform parents if a student does not reach the minimal outcomes required.
We can still achieve a "number" to fit in with the rest of the school until there is some sort of general move towards profiling.

This policy to be reviewed and developed in semester 2 1996.

The Science Staff
1. YEAR 7 - 8 POLICY

Students will be assessed for both Half Yearly and Yearly Assessment on the following basis:

- Class Tests 60%
- Assessment 40%

100%

Class Tests are on the basis of topic tests. Each topic should be tested in an appropriate manner.

Yearly Exam is 15% of Final Class Test Component.

Assessment tasks may include individual tasks such as Practical reports and tests, assignments, bookmarks, effort or commitment marks. Each teacher will use their own scheme to achieve the assessment mark.

2. YEAR 9 - 10 ASSESSMENT

Students will be assessed for both the Half Yearly and the Yearly grades on the basis:

- Topic Tests 40%
- Yearly/Half Yearly Exam 30%
- Assessment 30%

100%

Assessment is an individual classroom teachers responsibility to make up for each class. The Half Yearly and Yearly exam should include a common section and an extension section for each individual class.

Year 9 - for final assessment, include Yearly exam in 2nd assessment 20% of Exam Mark.

The common section will be used to obtain a comparison of each class for final grade.

Note: For final Grade in Year 10

- Trial Reference 20%
- Half Yearly Assessment 30%
- Grading Test 20%
- Final Assessment 30%
The Project Has Led the Science Team to Develop a Number of Initiatives So that Learning Opportunities Are Developed for All Students

1. Outcomes Based Programming in 7 - 10. This has included an evaluation of assessment and Tentative Moves towards Profile Reports in Year 7.
2. An Active Streamwatch team.
3. Science Interest Afternoons with Students working Individually on Projects of interest to them
4. The Very Successful Model Solar Car Competition - our car ended up 4th in the State.
5. The Planned commencement of a Cluster Based Solar Car Competition in 1995
6. Entry in the Uni of NSW Science Competition this has a National Profile.
7. Participation by Staff as Lecturers in Science Study Days (under organisation of Mitchell science Teachers Association.
8. Staff as Office Holders in the MSTA.
9. Successful Entry in many Science Competitions - Run by BHP, and Science Teacher's Association of NSW.
10. Planning of Individual Lessons using the Direct Input of Students through the Teacher Learning Project.
11. Presentation of Oberon High Project at International Education Forums in San Fransisco and Toronto.
environment. Furthermore, the teachers identified that these nominated features did not act in isolation. They all contended that it was the connections between the features that supported change as they kept linking to other features which they described as "cycles" of change. This is represented by the spider web that connects the principles in the proposed model, although there was no effort on behalf of the teachers to show all the connections between the features in their models. What is pertinent, however, is that the teachers acknowledged the importance of the relationship between the features of the program that enhanced their understanding of their practice and that their learning was non linear (see Appendix L and M).

Features of the professional development program that constrained how the teachers understood their practice.

The three teachers agreed that their reflective journals did not enhance their understanding of their practice. The original purpose of the journals was to assist teachers with their reflection on their practice and to enable them to document any changes. Although they did use the journals for the first few months of the program, they ceased using it after this time. Both Craig and David mentioned that they could not see the point of it and it was a low priority on their list of daily duties.

A lack of time for discussion constrained the teachers developing a better understanding of their practice. The teachers claimed that the program generated a good deal of work as all science programs for years 7-10 were re-written as well as several policies. Furthermore, with the busy routines of secondary school teaching, the teachers needed more time to share their ideas with their colleagues. They thought that the three professional development days during the two and a half years were invaluable in terms of providing time for sustained discussion that developed a trust which is necessary for such a community. Furthermore, the follow up meetings and informal discussions that resulted from these days were useful, but they needed to be more regular. In 1996, the teachers are intending to have fortnightly meetings to provide more continuity in their discussions.