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UMI
An Action Research Study of Secondary Science Assessment Praxes

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Education
Department of Curriculum, Teaching & Learning
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This practical participatory action research study illuminates the assessment praxes of four Ontario secondary level science teachers at one school using a facilitative approach. Participants were joined by a thematic concern, that is, a commitment to inform and improve assessment. Hence, two distinct sets of research questions emerged. The first involves the nature of assessment as we asked, what was the current state of assessment practice in secondary science? What were participants' initial understandings of assessment and actual practices at the onset of this research? To what extent did these initial understandings and actual practices change due to the illumination of assessment praxes through action research involvement? What was their level of awareness of current Ontario government pronouncements and in what ways did they implement this knowledge? The second theme, concerning the nature of action research, was realised by asking what did participants learn about action research? What other learning and professional gains were realised
during this study? And, what did I learn about action research and assessment through my involvement in this study?

Data were collected via supportive discussion groups, individual interviews, classroom visitations, journals and documentation. This professional development experience facilitated 'interactive professionalism' as teachers worked in a small group and interacted frequently in the course of planning, testing new ideas, attempting to solve different problems, and assess the effectiveness of those ideas. In addition, this action research effort was strategic and systematic, to attain a high degree of specific interactions, (personal interviews, group meetings, classroom observations, evidence collection). This series of deliberate and planned intentions helped participants solve assessment dilemmas. We developed an awareness and understanding of the need for more preservice and inservice assessment training. Participants realised the extent, and need to overcome their compartmentalisation, individualism and isolation. This reality was due to the design of their schedules, their school building and lack of common preparation times. Yet, in spite of the aforementioned, this inquiry supported and facilitated the transformation, improvement and enhanced understanding of assessment praxes. Participants learned how to professionally develop themselves using an action research mode of inquiry that supported teacher growth and development.
Hindsight: A tool for change

Each of us assimilates into himself something of the values and meanings contained in past experiences. But we do so in differing degrees and at differing levels of selfhood. Some things sink deep, others stay on the surface and are easily displaced. (Dewey, 1934, p. 71)
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Introduction

This study illuminates assessment praxes of four Ontario secondary school science teachers using an action research mode of inquiry. The illumination of assessment praxes reveals what is being done, why it is being done, how it is being done and who is doing it. The term praxis, henceforth, is understood as an established practice and praxes indicate several established practices. To illuminate praxes required a non-evaluative mode of collaborative, participatory action research. Participants "... in participatory action research are joined by a thematic concern, that is, a commitment to inform and improve a particular practice" (McTaggart, 1997, p. 30). Hence, this examination of assessment praxes is linked thematically to a commitment to inform and improve assessment praxes of these four teachers. Collectively, these teachers and I chose science as the context in order to examine our current assessment practices. We did this because Ontario science curriculum guidelines employed in 1998-1999 were more than 10 years old (Appendix A), and the extent and form of implementation of these guidelines had remained largely unexamined. A new science curriculum did arrive, via the Internet in March 1999, however its release followed the writing of this thesis.

A premise of this research is that collaborative examination and critical scrutiny of assessment praxes will enhance participants' awareness and understanding of assessment theory. This, in turn, will impact upon their practice and precipitate change. In other words, participants will see, think and act differently. This
assessment transformation is, therefore, a professional development experience that nurtures improvement as it occurs through collaborative, informed reflection, discussion and commitment.

Problem Rationale

This study attempts to answer these two sets of research questions. The first set involves the nature of assessment, as I asked, what was the current state of assessment practice in secondary science? What were participants' initial understandings of assessment and actual practices at the onset of this research? To what extent did these initial understandings and actual practices change due to the illumination of assessment praxes through action research involvement? What was their level of awareness of current Ontario government pronouncements and in what ways did they implement this knowledge? The second set of research questions, concerning the nature of action research, was addressed by asking what did participants learn about action research? What other learning and professional gains were realised during this study? Lastly, what did I learn about action research and assessment through my involvement in this study?

The provincial government's appointed expert panels have been examining each secondary subject these past two years as part of the reformation of secondary education in Ontario. As a result, a number of final reports were released by the
Ontario Ministry of Education and Training in June of 1997. These reports included an overall synthesis of all expert panels and detailed subject-specific submissions that explain the strengths, weaknesses and possible changes in most areas, including science education.

One of the motivations for reform stems from the need for improved academic achievement in Ontario classrooms (Snobelen, 1997). The government drew this conclusion from mandated province-wide assessments, which produced results that were less favourable than expected. There have also been international assessments of Canadian students in science and other areas that have provided the impetus for the Government of Ontario to refashion Ontario curricula. Teachers have already received some of the new elementary curricula (Ministry of Education and Training, 1997, a, b; 1998), which the Ministry claim are based on 'rigorous high standards'. The new curricula are in place for grades 1 to 8 as of September 1998, and the secondary curricula may be in place sometime in the latter part of 1999, for implementation in September 1999 or 2000.

The government has used these assessment results; first, to create controversy and then to instil a perceived need for educational change in Ontario. Results have been used as evidence of the need to make curriculum changes that impact very substantially on teacher assessment practices. Inevitably, these changes and reforms create anxiety for teachers. It could be argued that the problem is a direct consequence of inappropriate suggestions, policies and poor strategies for change.
relating to the *Education Quality Improvement Act, 1997 (Bill 160)*. One reason for these governmental errors is a lack of information about current practices. Therefore, teachers feel insecure (Hargreaves & Fullan, 1998). They feel that their knowledge and experience are under-valued and disregarded in government policy making. So, in order to respond to these changes, teachers need to increase their skills and knowledge to lead and influence government towards common sense outcomes. The goal is attainable through informed research led by teachers, which then can be used to broaden and sharpen the narrow and distorted views of the Ontario government. By doing this, proactive educators can supply more accurate, valid and authentic portraits of education and, especially, assessment. One means to achieve this is by entering into action research commitments with other educators.

At a January 24th, 1998, meeting of the Ontario Curriculum Forum in Toronto, Pauline Laing, Project Director of the Ontario Curriculum, Learning and Teaching Branch stated: "We do not know what is going on in Ontario classrooms as we have no formal feedback mechanism." This response came after this writer put the question: How can the Minister of Education for Ontario propose changes if an assessment of current practices has not been undertaken? Further, this writer asked, How does the Ministry of Education for Ontario plan to develop a feedback loop so that the changes are informed, rather than not? Again, Ms. Laing stated, “There is a need to look into Ontario classrooms to see what is happening”. This action research study is one attempt to arm teachers with assessment insight, knowledge and
perspective. This effort complements a current trend in Ontario that addresses classroom practices as part of a professional development enterprise.

(Metropolitan Toronto School Board, 1996a; Russell, 1995)

Now, while the Ministry of Education has suggested assessment methods in each of its curriculum guidelines (Appendix A & Q), the degree of implementation has been largely left to the discretion of individual teachers (OSIS, 1984). Furthermore, the Ontario Secondary School Teachers' Federation (1994) has stated:

Ontario must strive to do a better job of assessment and evaluation — to keep the focus of student assessment where it should be — in the hands of the classroom teacher. . . . The 'clients' of the school system want to know — what is being done in classrooms, — why it is being done, and — how well it is being done. (Midwood, O'Conner & Simpson, 1994, p. 8)

Indeed, the choice of assessment strategy will also determine the curriculum. Consequently those intent on curriculum change should first gain control of assessment policy and practice (Kempa, 1986). Anthony et al. (1991) add:

Until assessment and evaluation are seen to be classroom research oriented, active processes of making judgements that involve all the participants, and that are integral parts of the curricular process, it is doubtful whether change can or will occur in our schools. Ultimately, what is taught in the classroom will be determined by the assessment and evaluation programs used, and if changes are to be made in educational practices, evaluation procedures must also change. (p. 21 - 22)
To provide a window on current praxes and enhance teachers' assessment practices, professional development is necessary. In this study, reflection on assessment praxes, which included the teachers' values, beliefs and theory, was achieved using an action research participatory mode of inquiry. Why use the action research mode of inquiry? Quite simply, "action research has the potential to improve education as does no educational innovation of the past century" (McLean, 1995, p. 67). Action research is a means,

...to sort out not only one's values, beliefs, motives, but also to give more attention to the analysis of the experiences of the classroom: new perceptions may lead to altered conceptions and reconstruals of aspects of the art of teaching. . . . Reflection on one's everyday professional world 'seems an important entry to a deeper understanding of educational innovation and change. Through such reflection and revaluation the teacher may gain a clearer sense of the way in which the past shapes and informs possibilities for action in the present. (Rudduck, 1991, p. 94)

Hence, the action research method of inquiry employed in this study was key to understanding the problematic nature of assessment. It allowed our committed participants to critically examine their individual assessment practices through reflection and discussion, both individually and in a small group. Thus, this action research experience was very much a professional development experience (Zuber-Skerritt, 1996), supported by participants.

This study is both unique and necessary because teachers are usually isolated (Royal Commission on Learning, 1994), and are rarely able to discuss fundamental
matters with other educators, unless exceptional measures are put in place at great effort and expense (Fullan, 1992). This inquiry requires a series of commitments beyond teachers' normal workday. Wood (1993) explains:

An additional and often overlooked time problem is one having to do with lack of time for teachers to work together as a team. In many of today's schools it is almost as if someone designed the school day with the express objective of keeping teachers apart . . . most teachers seldom have opportunities to talk with their colleagues during the day. For that reason it is hard for them to view the school as an entire unit . . . . As with other working people, teachers need time structured into their days to work on their work. (p. 242)

Along with the ever-present isolation, it could be argued that teachers, in the 1990's, have more responsibilities, issues, problems, constraints and societal expectations placed upon them than at any other time in Ontario's history. As such, when teachers plan to meet, they often need to negotiate obstacles such as problematic economics and daunting logistics, as noted by Wood. Likewise, Fullan and Connelly (1987) remark that our schools were designed for people using ideas and management techniques of another era. For example, " . . . the teaching profession does not often allow time for, and its culture does not support, either communal reflection on practice or discussion of basic philosophies " (Rudduck, 1991, p. 92). Another contributing problem is that teachers have been denied adequate preservice training in assessment. " Most teachers have had little formal training in assessment and even those who have had training have found that it was not very useful in classrooms " (Earl & Cousins, 1995, p. 13).
Combined, this isolation, lack of communal reflection and inadequate preservice training in assessment, suggest a pressing need for action research. Action research is a classroom-based curriculum-in-action research tool that promotes professional growth and aids development, in this case, of assessment praxes. By employing action research methods in schools, teachers will be able to connect, exchange and grow together professionally (Zuber-Skerrit, 1996).

Some action research is aimed at the systematic collection and analysis of information for the purpose of informing political action and social change (Barnsley & Ellis, 1987). This current study is systematic, informing, and brings about change through reflection and discussion. Ontario action researchers have been moving forward with guidance and support from Ontario University action researchers (Hodson, 1994; Pedretti, 1994; Russell, 1995), Ontario Teacher Union funding (Elementary Teachers Federation of Ontario, Ontario Secondary School Teachers Federation), and secondary and elementary classroom research (Obiero-Owino, 1994; Ryan, 1998a; Simonson, 1994). Educational action research has been described as a systematic process of acting, reflecting and revising teaching praxis in order to professionally develop on the job (Stringer, 1996). It is to this end that the current study aims to take what is heard and turn it into sight and vision for all to reflect on and read.

Teachers as researchers confront the issues, the critics and themselves, in order to transform, improve and facilitate achievement of students. Action research is not "...
. answering critics by hanging on to existing practice and defending the status quo . . .


Teachers rightly object to achievement data being used in crude and misleading ways to rank schools in published league tables of performance (taking no account of the different kinds of communities in which these schools are placed). Yet there is no use trying to keep the lid on performance data. Instead, the most effective teachers wade into the fray contesting what is misleading, and creating meaningful, well rounded school profiles to communicate what goes on in their classrooms. You can run but you cannot hide from the chaotic and complex environments surrounding schools today. (p. 23)

In sum, this study involved four committed Ontario secondary science teachers from one science department at one school. Each teacher agreed to participate in an action research project that could, ultimately, transform his or her assessment praxes and contribute to his or her professional development. As a result, participants realised new understandings of assessment, teaching and self via recursive bouts of reflection, discussion, observation and action. The records developed via tape-recording, journals and document collection preserved events, practices and voices that may be used by others searching for answers to fundamental questions of an educational nature.
Chapter 1

Secondary Science

1.1 Government, Curriculum, Assessment and Science

Introduction

This chapter addresses the role currently played by government in the area of education and curriculum. I explain how several educational stakeholders influence curriculum development. These include society in general, government, school boards and teachers. As well, a definition of curriculum is provided which connects it to a purpose and a level of conceptualisation. I point out how the definition can position certain facets of curriculum, such as science, in prominent roles because of its potential to provide economic prosperity for Canadians. Finally, I suggest how a mode of inquiry such as action research is the soundest approach to investigate such a vital aspect of the Ontario curriculum and in doing so, it is my contention that this is the one of many ways to ensure that significant change occurs in the classroom.

Government

In Canada, responsibility for elementary and secondary education is delegated to local boards or commissions. In turn, these boards shape school curriculum within provincial guidelines supplied by the provincial and territorial Ministers of Education and the provincial and territorial departments of education (Government of Canada,
1997). Thus, it is largely the provincial governments that administer the various facets of secondary education in Canada.

One of the target areas that the provincial governments administer, and are primarily responsible for, is curriculum. Currently in Ontario, every secondary science teacher awaits the new 1999 Ontario science curriculum, which is to be released by the Ontario Ministry of Education and Training in 1999 (Internet - March, 1999), with an implementation date of either September 1999 or 2000 (G. Connelly, personal communication, May 2nd, 1998). It could be argued that the secondary science curriculum and the teaching of science constitute one of the most important areas of study in education in Canada. Mayberry (1997) explains:

A key to Canada's long-term success and prosperity will, in fact, be the ability of present and future generations to develop and use technology that creates prosperous, competitive businesses, capable of succeeding regionally, nationally and globally. To get there, our young people need to understand the need for, and benefit of, entering into fields of science and technology . . . . These are people who ultimately will be our leaders in research, wealth creation and prosperity—the ones who will create a competitive industrial base. (p. 153)

Unfortunately there are many obstacles for science students and teachers. One obstacle, identified by Johnston (1994), is widespread teacher feelings of marginalization and pressure from imposed curricula that pay scant attention to the realities of classroom life:

The strength of the notion that curriculum relates only to written
documentation, usually prepared by others, appears to contribute to many of the negative perceptions of curriculum held by these teachers. Almost ironically, their teaching is dissociated from the curriculum, but they still feel the very real pressure exerted by curriculum on their teaching. For secondary teachers, their stories of curriculum revolve around their experiences of coping with school-developed work programmes, which are handed to them by their subject co-ordinators. Few report being involved in developing these work programmes and those who have been involved report this involvement as being very marginal. Their stories build a picture of these work programmes dominating their lives as teachers and they feel bound to cover all of the work listed in the programmes. (p. 534)

Along with the marginalization of teachers there is considerable public disquiet resulting from Canada's relatively poor showing on an international test of mathematics and science attainment, with Ontario well below the National average (Lewington, 1997). However, Maureen Morris, president of the Canadian Teacher's Federation suggested, "... it was unfair to make comparisons because curriculum vary from one province and territory to another " (Lewington, 1997, A10), therefore the opportunity to learn certain aspects of science may not have been available to some students. In other words, the test covered areas that were not in some provincial curricula. Regardless of these curriculum differences, and the differing provincial priorities, the Government of Canada (1990) suggests:

Despite the jurisdictional problems that plague education reform in Canada, it should be possible to work toward common reforms at the National level . . . . It is clear that improving science education is crucial to the long-term health of the Canadian economy. In a society where science education and technology are pervasive, knowledge of and facility with science is essential for all citizens. Science education must begin with a firm base in primary school but it must continue into
secondary school, university and beyond . . . . Without this ability, Canadians will have a great deal of difficulty in competing in the global economy. (p. 10 - 11)

Previous Federal Government of Canada initiatives have produced documents such as: Science Education in Canada - Volume I (1985) and Volume II (1989) by Connelly, Crocker and Kass and Science Education In Canadian Schools - Volume I, II (1984) by Orpwood and Alam (I) and Orpwood and Souque (II). Unfortunately, their impact at provincial levels has been fairly minimal. So, are the prospects any brighter at this time? Probably not, yet we must try to make a contribution somehow, especially since the 1987 Ontario provincial secondary science curriculum guidelines are being changed in 1998 and 1999. The task facing teachers attempting to meet the newer secondary science directives is formidable, especially if, "science education for the twenty-first century must be far reaching . . . [and] must embrace human values and create a positive climate for learning " (Ministry of Education and Training, 1997c, p. 1).

Ontario teachers may well not feel that they can wait any longer for a new curriculum. Some may begin the task of curriculum renewal themselves. Even if teachers do wait, the demands of the new document will put considerable implementation problems onto individual schools and teachers, especially if the current grade 1-8 Science and Technology curriculum document is an indication of what can be expected. We have many reasons to begin the renewal ourselves, now, as
Hargreaves and Fullan (1998) point out:

Although schooling is becoming more centralised in some respects, through the proliferation of curriculum targets, learning standards and achievement tests, the day-to-day management and responsibility for meeting quality standards and performance goals is increasingly a matter for individual school determination. (p.16)

Curriculum

Curriculum, as defined by the Ontario Ministry of Education and training (1997c), is " . . . the plan for student learning, which is implemented in schools " (p 15). The plan usually includes, but is not limited to, goals, aims, objectives, outcomes, content, modes of delivery, assessment and evaluation suggestions, implementation schemes, partnership proposals, and review and renewal recommendations. Curriculum is developed, in part, by Ministry of Education personnel who are distant from most teachers in Ontario. Once developed, it travels through an administrative process that externally adapts it to various classroom contexts throughout the province. Eventually it reaches the employee/teacher of various school boards throughout Ontario, where it is interpreted and implemented.

Alternatively, it can be proposed that curriculum, . . . encompasses the interaction of students, teachers, and subject matter—in a school setting and in a context of educational purpose. Thus such matters as planning and instruction, which are often separated conceptually from curriculum, are treated . . . as integral components of it. (Connelly, Dukacz & Quinlan, 1980, p. 3).
The task of reaching consensus on a definition of curriculum may not be the most significant goal. John Dewey explained that the valuing of the process of theorising is of primary importance, whilst the resulting definition is a secondary product of theorising and less important (Clandinin & Connelly, 1992). Similarly, action research is a means to get teachers involved in theorising and, following Dewey, it could be argued that the processes are more significant than the particular outcomes (for example, the kinds of assessment instruments they design). This point is crucial to a proper evaluation of the educational significance of this thesis.

In practice, what is written in curriculum documents and discussed in public forums is often very different from what occurs in classrooms. There are two levels of reality: The theory, and the practice of (secondary science) education. Realising this mismatch, Orpwood and Souque (1984, p.28) point out, "research into science education must be planned to take into account the existence of these two levels (and the inevitable discrepancies between them)." This perspective contrasts with the dialectic view of theory and practice put forward by McKeon (1952) and underscored in Connelly and Clandinin's text entitled Teachers as Curriculum Planners (1988), where the authors state: "Indeed, practice is theory in action. There is no essential dichotomy " (p. 95). This is the position adopted here: Theory and practice develop together, each informing the other. In essence, this is the position underpinning the action research approach to curriculum development and teacher education. Action research puts a high value on reflection and theorising as precursors to, and
interactive with, curriculum action. Action research, like curriculum, is a process that brings about change; it is not just empty rhetoric or a definition game.

Science Curriculum: Assessment


... Students have limited ability to gather and evaluate information from a variety of resources. They have difficulty reading effectively, understanding what they read, and communicating orally and in writing. They often lack the ability to think critically, evaluate data ... Many have poor problem-solving skills and cannot identify solutions ... [they] are not sufficiently self-motivated, independent, and active learners. Students also showed inconsistencies in knowledge, skills ... This might be a result of inconsistencies in standards and evaluation, teaching, implementation strategies, and contextual relevance and application. There is ... overemphasis on content ... memorisation, a focus on examinations, and poor retention over time. (1997c, p. 9)

By drawing attention to current weaknesses, the expert panel has provided a list of priorities. Therefore, the 1999 science curriculum should present improved opportunities for students to be self-directed, to gather information, perhaps from the Internet and concretely throughout the local community. The new curriculum should include higher order thinking skills (HOTS), such as evaluation. It is essential that literacy skills, including reading, writing and speaking be supported, while including metacognition and nurturing critical thinking via HOTS. Given such changes, the
curriculum may be better placed to facilitate problem solving, instil motivation via novelty and, most importantly, make science appealing to the student. For a complete comparative analysis of the key assessment features refer to the following documents: Ontario Ministry of Education, 1987a; Ontario Ministry of Education and Training, 1997c; Ontario Ministry of Education and Training, 1997d (Appendix Q).

The new 1999 science curriculum will have missed a crucial opportunity, should it fail to include more practical hands-on concrete learning opportunities. Lastly, the 1999 science curriculum should include more alternative and varied assessments that address a greater Science-Technology-Society-Environment (STSE) focus.

A computer compact-disc entitled ONED, 1997, recently released by the Ontario Curriculum Clearinghouse, expresses the goals of science education as follows:

Science is both a body of knowledge and theory about the natural world and a set of principles or methods for investigating and explaining aspects of the world. These theories and methods are constantly being re-evaluated, as new information becomes available. Students will become aware that scientific accomplishment, both in the past and in the present, is a result of the efforts of women and men from diverse races and cultures to meet human needs and to understand how the world works. Students will also have opportunities to see that scientific study can inspire a sense of wonder and respect for life and the environment . . .. Students must be able to use scientific language, models, symbols, methods, and equipment in their work. (Ontario Curriculum Clearinghouse - Part 3: Program Areas and Specific Learning Outcomes - Mathematics, Science, and Technology)

Undeniably, there is an interrelationship among curriculum, instruction, and assessment (Fullan, 1997). The form and style of assessment can act as a powerful determinant of classroom practice. Unfortunately, these expectations of eventual
performance can easily become accepted as the educational goals themselves, and so can distort and trivialize education (Hodson, 1993a). For example, teachers attempt to promote a particular performance from students via provision of models or exemplars. The assessment targets (outcomes) noted in the previous block quotation are somewhat vague, yet they are useful, without being overly prescriptive. Assessment targets mentioned elsewhere include scientific literacy, which can be observed as real-life communicative abilities or as "... the acquisition of science knowledge, skills, and attitudes needed to function and contribute successfully in the world" (The Ontario Ministry of Education and Training, 1997d, p. 3). As well, the use, understanding and application of models, symbols, methods, and equipment in student work are considered important. Moreover, assessment of student work is expected to consider both the process (formative) and product (summative). Clearly, the assessment task is complex, and will be further addressed in chapter two.

If the new curriculum can help teachers to achieve such lofty yet necessary change in Ontario secondary science, it will be greeted and welcomed. However, the new curriculum may arrive in the same manner as it has in the past, with teachers excluded from the development process and no professional development in place to usher in the changes. If this happens, and it looks as though it will, there will be a great deal of turbulence. Fullan (1992) tells us, "the more complex the change—the greater number of parts, of actors, of changes required in working arrangements, curriculum components, instructional practices, training and assistance devices—"
greater the chance of internal turbulence" (p. 6). Some teacher-researchers are actively preparing for such a change by involving themselves in professional development activities, many in an action research format. At a time of uncertainty and anxiety, involvement in these kinds of activities can be a 'lifeline' for teachers.

Science & Action Research

Science can be a means to investigate questions and as an outcome this can lead to new understandings. The common thread of science and action research can be seen in the communicative requirements of investigators to share their findings in a manner that is easily grasped. This communicative action is a challenge in any field of endeavour. Indeed, the communicative action underpinning curriculum delivery is not an easy task in busy secondary schools. Educators are consumed with individual schedules and diverse student needs. The mere administrative tasks require most of the available time, with staff meetings held infrequently, either before or after school.

In an educational text entitled Innovation and Change, Rudduck (1991) explains:

... building shared meaning among members of a school staff (let alone between teachers and their pupils) is easier said than done. There are few institutional conventions that support time spent on exploring the meanings that underpin practice ... we do not always make time to explore each other's views of teaching and learning ... the word colleague can refer to a relative stranger on the other side of the wall ... Teachers have to maintain their commitment to present structures while planning new approaches; they have to fulfil present expectations while considering strategies for changing those expectations. They will experience, to say the least, a mild schizophrenia. The appropriate virtues for the task of fundamental curriculum change are imagination, patience and immense
fortitude. (p. 31)

It is these same virtues that are required for action research commitments. As the secondary science curriculum is discussed, theory and practice are illuminated in real ways so as to bring out not only what is good, but also what is not so good. By doing so, we explore our differences; it is as if dissent were legitimised (Fullan, 1997).

Disagreement over science curricular issues, including assessment, must be carefully considered or "...it gets repressed, to emerge later as a pervasive sense of injustice, followed by apathy, resentment, and even sabotage" (Champy, 1995, p. 82) (cited in Fullan, 1997, p. 18). Sharing brings people closer together and a sense of relief is felt (Johnston, 1994). While it may be easier to look at what works, it can also be prudent to look at what doesn't work, and at differences, resistance and alternative theory and practice.

The ability to carry out action research is dependent upon capturing enthusiasm and commitment to change. Gray and Wilcox (1995) suggest three key factors, the most significant of which:

... is the question of ownership. For improvement to take off, a body of staff within a school need to agree amongst themselves (and with the management') that there is 'a problem' which needs to be tackled, that there are some strategies which could be explored and that they will search out the solutions for a while. (p. 252)

Action research is a way of circumventing the problems of isolation and marginalization referred to earlier. By taking communicative action in research,
teachers can transform their consciousness through reflection on current practice (Clandinin & Connelly, 1992). They can then consider alternatives, plan and implement them and engage in rigorous evaluation, thereby effecting considered change (Hodson, 1994). The sense of teachers supporting each other in their efforts to refashion assessment in the curriculum creates enthusiasm as ownership takes root and commitments increase. By communicating within an action research forum, teachers can effect real, significant and long lasting curriculum change.

Another reason for choosing practical action research was found in The Royal Commission on Learning (1994), which suggests:

We know that teachers need to continue to learn and develop throughout their careers, and it turns out that one of the best vehicles for such growth is the school itself. One of the most effective ways of promoting both teacher growth and student learning is for teachers to work in a setting that emphasizes two things: continuous improvement of teaching, and regular monitoring and feedback about results. In other words, a 'collaborative culture' focused on instruction and student achievement is a powerful force for improving schools. . . . in-school professional development. (Volume III, p.6)

It seems odd that the word action research was not used in the Royal Commission Report. Perhaps this is because this mode of inquiry is still in its infancy in Ontario and its language would not be familiar to the general public. However, the action research process is developing slowly but steadily via University, School Board and teacher union support, and through applications such as this research. One of the best ways to achieve a stronger collaborative culture is for Ontario science teachers to engage in practical action research. By becoming a teacher/researcher, the
teacher learns first hand what skills are essential and learns to fine-tune their
capacity to facilitate inquiries. Hargreaves and Fullan, (1998) add:

Teachers today need to do much more learning on the job, or in parallel
with it - where they can constantly test out, refine and get feedback on
the improvements they make. They need access to other colleagues to
get learning from them. Schools are poorly designed for integrating
learning and teaching on the job. The teaching profession must become
a better learning profession. (p. 83)

Similarly, Hodson (1994) adds:

It is my contention that effective curriculum development and
implementation requires that groups of teachers who know students, the
locality and the school environment well, are brought together to work
on theoretical and practical issues related to the design and
implementation of a new science curriculum in a critical and supportive
environment. (p. 93)

As well, McNiff, et al. (1996) explain: "An important principal of action research is
for the research to be educational in the sense of self-developing. It is through
enquiring into our own practice that we are able to create a living form of educational
theory . . . " (p.10-11).

In sum, an essential purpose of this chapter was to demonstrate that the Ontario
Ministry of Education makes certain pronouncements concerning the science
curriculum and assessment practices, yet it is the teachers who have to implement
these pronouncements. To do so, teachers have to understand them, which requires
certain levels of both assessment and scientific literacy. If these levels of literacy are
adequate then teachers may show support for the pronouncements.

The notion of assessment literacy demands that educators have a practical understanding of the diverse and complex means to assess and evaluate. Assessment strategies are broad today given the many forms, functions and styles available. This fact is best understood after reading the next chapter concerning assessment (Chapter 2). Clearly, assessment has become more central in curriculum planning (Griffin, 1998); expectations for both students and teachers have changed and the diversity and complexity of notion of scientific literacy underpinning contemporary science education has matured. Therefore, the changes in curriculum create clear requirements for educators who must shape and adapt it in several respects in order to “translate it” into action. Getting a deeper understanding and achieving the necessary sense of ownership is best achieved, in my view, by utilising action research.
Chapter 2

Assessment

Introduction

This chapter defines assessment, presents a current assessment paradigm, and suggests 'why' (function), 'what' (target) and 'how' (form/methods) educators assess. As well, information concerning how assessment data are interpreted and recorded is included, along with the means of reporting and communicating assessment information.

2.1 Assessment: Defined

Assessment is a means of collecting data. It can also be a means for teachers to "... wade into the fray contesting what is misleading, and creating more meaningful, well rounded school profiles to communicate what goes on in their classrooms" (Hargreaves & Fullan, 1998, p. 23). Thus, assessment can be a positive force that motivates and leads to growth. Conversely, assessment data can create tensions for teachers, which may lead to professional debilitation. "Teachers rightly object to achievement data being used in crude and misleading ways to rank schools in published league tables of performance (taking no account of the different kinds of communities in which these schools are placed)" (Hargreaves & Fullan, 1998, p. 23).
The Ministry of Education and Training (1997c) reiterates what it sees as the relationship between assessment and evaluation, identifies the key areas of concern, and emphasises the importance of flexibility (form/function) in assessment procedures:

Assessment is the continuous and ongoing process of gathering information that is used during evaluation. . . . Ongoing assessment also indicates to teachers where adjustments are required to curriculum content and materials, teaching methods, student learning experiences, and assessment techniques. The assessment of students' performance must be accurate, fair, and based on curriculum requirements. Student achievement must be measured by a selection of assessment strategies that would allow students with different learning styles to demonstrate their achievement of the curriculum requirements. Assessment criteria should be understood by students and be consistent with the purpose of the assessment . . . . Students should be . . . assessed on their demonstration of: - intellectual/cognitive achievement (capacity to retain, reproduce and apply knowledge); - practical achievement (performance-based); and - personal and social achievement (teamwork, co-operation, innovation, initiative, originality, and time management). (p. 39-40)

So, as educators collect student data they are actually carrying out assessment.

However, assessment is often misunderstood by teachers and needs to be clarified. Many Boards have endeavoured to do what The Metropolitan Toronto School Board (1996a) has done, and that is, summarise key assessment principles in an effort to refine and standardise teacher data collection:

1. Assessment must involve the use of a wide variety of methods so that the evaluation of students' achievement is as accurate as possible.
2. Assessment, evaluation, and reporting are the responsibility of the teacher, who must consider the needs of individual students and work closely with them and their families.
3. Assessment, evaluation, and reporting are continuous and essential parts of curriculum and effective classroom practice.
4. Reporting must describe the student's progress towards achieving the outcomes and must include plans for improving the student's performance.
5. The evaluation of programs should lead to their improvement and should focus on their effectiveness in preparing students for work. (p. 2)

Based on these principles, the resulting assessment information would be classroom based and controlled by teachers. Therefore, it would more closely reflect the student's local curriculum, level of understanding and achievement.

2.2 Assessment Impetus - Why

Assessment is a responsibility entrenched in school policy and Ontario laws. Every Ontario teacher has a lawful duty to "... teach diligently and faithfully the classes or subjects assigned to him by the principal " (Government of Ontario, 1990, p. 518), and "... under the Education Act and its regulations, teachers are responsible for: evaluating pupil learning and progress ... " (The Ontario Ministry of Education, 1982, p. 4). To fulfil this legal obligation, each Ontario teacher assesses students in the best way he or she can.

The Royal Commission on Learning (1994) put forward the notion that "the most important use of assessment is as a way of finding out how students are doing in order to help them learn better, more, and faster " (p. 326). This view suggests that one purpose for assessment action is to inform and guide students, teachers and parents. Assessment, thus contains evidence that will provide feedback for parents,
administrators, teachers and students. As well, assessment data provides evidence concerning the extent to which the teaching and learning methods used are working. Assessment data also provides evidence of the extent of learning, whether expectations are met or achieved; it reveals levels of performance as well as the extent of student understanding. Furthermore, assessment data and evidence can pinpoint special needs, or can be used to summarise a unit. Conversely, a "... lack of [assessment] information creates uncertainty and anxiety; this is certainly true in the case of the lack of student assessment data in recent decades in Ontario" (Royal Commission on Learning, 1994, p. 136).

Teachers follow curricular guidelines in an effort to fulfil legal and academic responsibilities, one of which involves assessment - defined here as a means of collecting data. Data can then be used as evidence to support judgements concerning the progress, learning and needs of students. Assessment assists the planning and instructional efforts of teachers and is a key source of information to be communicated to parents, administration, and support staff and, in some cases, outside agencies. Teachers can assess to identify strengths and weaknesses in students, the classroom instruction and the program. Assessment data and evidence can be used to improve student learning by providing feedback for students, so that students and teachers alike can decide what comes next (Earl, 1996). Assessment can be used to identify high-risk learners and to classify students for special education purposes. Teachers can
assess themselves and peers to aid professional development and to inform administrators and fellow stakeholders. Naturally, with assessment being such an important aspect of education it is essential that the content (what) of any assessment be considered carefully.

In sum, it is generally understood that the multiplicity of purpose implies multiplicity of methods. In other words we use different tools for different purposes. Thus, different stakeholders (Ministry of Education, School Board Administration, school-based resource people, classroom teachers) prioritise different methods to achieve different results, which subsequently guide them in changing particular aspects of the curriculum. What is clear is that teachers may have priorities that are in direct opposition to Ministry directives because they seek to impact different areas of the curriculum. Moreover, classroom teachers may have priorities that are tacit and unnamed. Our task as action researchers is to name, clarify and document science teacher’s assessment praxes. By ascertaining our data teachers in this study may be able to realise a better understanding of why they are assessing, which can lead to better decisions about what and how to assess, and what to do with the data. In other words, debate about the purpose of assessment should have priority in this project.

2.3 Assessment Content - What

As argued above, what Ontario teachers decide to assess is influenced by their
reasons for engaging in the assessment (why). Often science teachers may be assessing to develop grades, to provide curricular evaluation, to aid teacher appraisal or to nurture student development and academic achievement. And, of course, they may decide to assess in one manner because of the most current assessment policy articulated by the Ontario Ministry of Education and Training, which is detailed in the next section.

It is important for us to know what and why teachers choose to assess in the science classroom. For instance, do science teachers assess concepts in science, student science skills, attitudes and/or social skills? Also, at what cognitive level does the assessment focus? For example, do they prioritise knowledge (lower order cognitive skill) over synthesis or evaluation (higher order cognitive skill)? With all of the governmental changes in Ontario education in the 1990's and the continued use of the 1987 secondary science guidelines we really do not have answers to these important questions. Therefore, it is necessary to have research that will shed light on these matters so that, in the end, we will have an idea why teachers assess, what they assess and how they assess.

**Current Assessment Policy**

The most current assessment directives issued by the Ontario Ministry of Education and Training arrived in Ontario schools within the Common Curriculum policies and outcomes for grades 1 to 9. However, due to a change in Ontario government, the
complete Common Curriculum for the secondary level never materialised. So, in 1998, teachers are required to assess in a manner that fulfils their legal and professional obligations, yet do so in accordance with science guidelines, which are more than 10 years old. Of course, the release of the new secondary curriculum may provide new prescriptions for assessment. However, as of September, 1998, secondary science educators can do no more than consult the 1997 documents analysed in Appendix Q, or examine the new grade 1 to 8 Ontario Science and Technology Curriculum (1998) publication, which includes a chart outlining four areas of achievement, and suggests an emphasis on:

... understanding of basic concepts, inquiry and design skills, and communication of required knowledge and relating of science and technology to each other and to the world outside the school. For each of these four areas, there are four levels of achievement. These levels contain brief descriptions of degrees of achievement on which teachers base their assessment of students' work. (p. 12)

Arguably, some of these areas (basic concepts, inquiry and design skills, knowledge communication) may be included in, or related, to the new secondary science curriculum to be released later in 1999. Therefore, secondary teachers need to think in terms of linking student performance to grades and descriptions, called strands, in order to assess effectively. Currently, Ontario teachers are ultimately responsible for the judging of academic skills and attainment of students in secondary school, especially those bound for post-secondary education (Royal Commission on Learning, 1994).
In summary, we need to know what teachers choose to target in their assessments in the Ontario secondary science classroom in response to the shift in curriculum emphasis from content knowledge of science to the application of science to solve real problems. The Ontario Ministry of Education and Training (1997d) adds: "Science education for the twenty-first century must be far reaching . . . . Students need to understand the links among science, technology, society, and the environment (STSE) . . . . Above all, science education must be relevant so that students recognise the link between it and real-world issues and problems" (p.1-2). This shift in emphasis causes us to take a closer look at science education. This closer look can impact our understanding and lead us to ask many questions.

For instance, do science teachers currently assess concepts in science, science skills, attitudes and/or social skills? If a particular domain is targeted, then we need to know at what cognitive level the assessments focus? Do science assessments target lower order cognitive skills over higher order cognitive skills, or vice versa? With frequent and thorough governmental changes in Ontario education in the 1990’s, and the application of older secondary science guidelines in Ontario, we lack clear answers to these vital questions.
2.4 Assessment Methods - How

Assessment in the 1990's has come to mean so many things and now represents a multitude of methods and forms. How we assess depends on our reasons for assessing (the 'why assess?' question). It is also determined by what we choose to assess (target): some content items lend themselves to one style of assessment, other content is better suited to other methods. Like all aspects of educational practice, current assessment practice will be a consequence of our previous experience and our assessment literacy. Assessment literacy involves different kinds of literacy (individual, department, Ministry), understanding and application of assessment terms (language), skills and strategies, which is agreed to and shared by colleagues (Hargreaves & Fullan, 1998). A teacher may be literate yet the department as a whole may be less so. Similarly, the Ontario Ministry of Education and Training may assume that their level of literacy is shared by Boards, departments and individual teachers when in fact it may not be. These levels of literacy relate to an understanding of the various assessment functions, forms and environments. In this study we illuminate individual assessment literacy and suggest departmental literacy levels based on this illumination. In addition to high assessment literacy levels, good assessment practice depends on sound teacher judgement, but judgement is always open to questioning. For instance, one teacher uses pencil and paper assessment only, whereas another relies on presentations, labs and performance based measures. One teacher allows students to rewrite tests until they reach a certain
standard, while another teacher permits only one attempt to pass a test. Discussion of these differences and their rationale can be mutually beneficial. It almost goes without saying that participants should be encouraged to look at the theories, values and interests underpinning their rhetoric and their practice. These can often be buried deep and often can be teased out while debating.

Earl and Cousins (1995) suggest "... there is a wide variety of assessment methods available for teachers to use. The trick is to employ the best method or methods to assess sought after outcomes" (p. 25). For example, student assessment can be in the form of self or peer appraisals, observations, checklists, rating scales, journals, interviews, demonstrations, photographs, videos, simulations, seminars, docudramas, conferences, independent study units (ISU), log books or presentations. The point here is that there are many creative means to gather both evidence and data. The interpretation of the data could take the form of criterion referenced (standards) or norm referenced (peer comparisons) assessments. Thus, teachers have to quickly become assessment literate in order to make sound assessment decisions. Teachers have to know and understand (assessment literacy) the assessment tool and related theory well before it can become a useful part of the curriculum. Ideally, teachers will ask: What assessment method would address the content best, and ensure both validity and reliability? Other questions relating to diagnosis and curriculum evaluation connect to reasons (why) for assessment and to attitudes, skills,
and/or socio-political awareness (what). Each reason for an assessment can be linked to a required method (how). Hence good assessment is very much a matter of carefully considering what, why and how to assess.

In a recent publication, based on the recommendations of an expert panel of science educators, the Ministry of Education and Training for Ontario (1997c) put forward several assessment suggestions:

We recommend multiple and varied methods of assessment . . . clear, consistent expectations. Alternative assessment methods, including journal, open-ended-problem, portfolio, interview, and performance assessments, should be used in addition to essay and multiple-choice tests. Practical, hands-on assessments should be included, and these assessments should also have an STSE focus. Authentic assessments involving evaluating the outcome of activities should be used whenever possible. Ongoing assessment should be linked to learning strategies and based on outcomes . . . It should also determine whether students are achieving the goal of scientific literacy. To be most effective, assessment must be used both to measure students' achievement and, as an accountability mechanism, to assess whether the program provides students with appropriate opportunities to learn. (p. 14)

Earl and Cousins (1995) add: " . . . Assessment is coming to be seen as integral to the learning process " (p. 25), and not just as something tacked on at the end. In the classroom, a teacher can make assessment an integral part of the curriculum by training each student to become assessment literate. A teacher can do this via self and peer-assessments. In Assess for Success (1994) the Ontario Secondary School Teachers' Federation further outline methods for student assessment, including the
traditional paper and pencil tests (true/false, matching, completion, short answer, multiple choice, essay), personal communication (instructoral questions, conferences, interviews, journals, logs), and lastly performance assessment (which may utilise written assignments, demonstrations, presentations, seminars, projects, oral tests, exams, anecdotal records, checklists, and rating scales) (Midwood et al. 1994, p. 171). This guidance is beneficial for teachers and has been echoed by the current Ontario provincial government via the expert panel examining science education in Ontario.

Assessment experts such as Stiggins (1994) suggest that the "assessment process can serve both as an instructional tool and as the basis for determining the effectiveness of schools " (p. 35). So, if assessment is instruction we may use it to "... discover what is valued by particular teachers or a particular school " (Harp, 1994, p. 276). Indeed, each assessment reveals something of a teacher's social values. Therefore, the teacher's philosophy of instruction may be uncovered by careful scrutiny of the assessment documentation. We may even realise that they use a particular assessment procedure because it's the easiest to organise and mark! Our exploration and illumination seems especially fitting for an action researcher who wishes to enter into a professional development experience with committed teachers. Our study provides an opportunity to criticise and give your opinion, to listen to others, reflect on and evaluate one's practice, its rationale, and to contemplate change. If change does
occur there are opportunities to explore these changes and to evaluate their impact.

It is possible that an individual science teacher's choice of assessment means will be better than the government's selected assessment mode. For example, the government favours province-wide testing of common content, by common methods, for policy purposes and teachers often favour curriculum-embedded assessment over a longer period of time for diagnostic purposes. Each form of assessment serves a different function. Such an assessment conflict is a direct consequence of different purposes for assessment. As teachers and administrators move forward towards assessment literacy, as defined earlier, they need a clear understanding of the two assessment strategies. Hein (1991) explains:

...generalizable, group-administered, context-invariant assessments, because they are relatively inexpensive, easy to administer, and easy to understand and interpret, are often considered more suitable for large-scale assessments for policy purposes. Individualized, longer and more curriculum-embedded assessments are considered primarily for their value to the classroom teacher, because they are more complex and the results are usually used for diagnostic purposes. (p. 84)

Therefore, as Hein points out, albeit in different terms, the government favours assessment for policy purposes and teachers favour assessment for diagnostic purposes. Thus, there is assessment conflict originating from the very purpose of each stakeholder's assessment. A question of immediate concern here is: How do
teachers in this study deal with the tensions and conflicts of interest? Secondly, what are the advantages and disadvantages of each mode of assessment?

**Assessment Modes: Pros/Cons**

For convenience, assessment can be organised into three categories. First, paper and pencil tests, which can be viewed as traditional means to assess students. Second, performance assessment, which can include both products and processes that may have been used to attain expectations (exemplars). The third category includes personal communications, which involves direct discussion with the student, either formally or informally. Each mode and category will be further defined and examined in the following discussion.

Traditional means of assessment include true/false, matching, completion, short answer, multiple choice and essay questions (Earl & Cousins, 1995). While each means of assessment has its particular strengths, it also has limitations (Wilson, 1996). For instance, true/false questions often assess content knowledge, narrow (lower) thinking skills and merely require students to identify and factually recall a correct answer, rather than produce one (Midwood et al., 1994). It could be argued that this means of assessment might actually target reading ability more than anything related to scientific understanding. True/false items (matching questions) often require students to identify relationships. This can be viewed as a positive feature, given the higher order cognitive demands of such a task. However, true/false
questions are sometimes limited by their factual recall demands (Midwood et al., 1994). Completion tasks (fill-ins) often require students to supply an answer yet this task may target primarily reading skills rather than knowledge or its application (Midwood, et al.). Detailed consideration of the pros and cons of each mode is not possible within the confines of this thesis, and interested readers are referred to the several texts dealing with these matters (Cohen, 1995; Darling-Hammond, 1994; Earl and Cousins, 1995; Farr & Trumbull, 1997; Griffin, 1998; Harp, 1994; Midwood, et al., 1994; Stiggins, 1994; Wiggins, 1993). What is important is that all teachers are aware of the strengths and limitations of different assessment methods; such awareness is a feature of assessment literacy.

In recent years it has been common practice for teachers in North America to use short answer questions, which have required students to recall factual knowledge, a lower level skill. These short answer questions seem to be able to assess content learning better than true/false, matching, or completion type questions (Midwood et al., 1994). Multiple choice questions, perhaps the most commonly used short answer items, are often cumbersome to devise, but easy to mark. They assess the student’s ability to read and select the right answer, but may focus only on lower level thinking skills. Traditional essay questions mostly assess writing skills and higher order thinking. However, they are difficult to mark because grading criteria can be elusive and because essays require large amounts of time to mark (Midwood et al. 1994). Problems then arise due to issues concerning uniformity, consistency and
standardisation. These issues do not sit well in the contemporary assessment climate.

Recent advances in assessment have caused a shift from traditional modes to modes that are more complex. For instance, the performance assessment mode describes "an assessment activity in which students construct responses, create products, or perform demonstrations to provide evidence of their knowledge and skills" (Pomperaug Regional School District, 1996, p. 277). This may include written assignments, demonstrations, presentations, seminars and projects. While performance assessment may be a rather new assessment term, it also applies to several traditional modes of assessment, including assessment of laboratory activities. As a result the term 'performance assessment' and its application can create confusion for educators.

Take, for example, a student’s written performance during an examination. This performance has been viewed as a performance-based paper and pencil task that has a long history in secondary education. Earl and Cousins (1995) explain that "performance assessments assess the actual performance of a complex set of activities" (p. 26). So, knowing the strengths and limitations of performance assessment is important and will be presented later. Most often, it is used as a summative assessment event. It is sometimes argued that performance assessment is 'authentic' and that most 'authentic' assessments involve a degree of student performance (Choate & Evans, 1992; Wiggins, 1990). Midwood et al. (1994) tell us
that " authentic assessment [requires] gathering information about a task which is genuine and occurs in a real-life context " (p. 408). Thus it is the complementary nature of these two modes of assessment that often leads to confusion. We can say that performance based assessments are not necessarily authentic, though all authentic assessments are likely to be performance-based. For instance, the safe use of a Bunsen burner does not mean that this task will be required in the world of work (real-life context).

The shift to performance-based assessment and authentic assessment is associated with the desire to make assessment more valid, to make it more like "the real thing", to ensure that it focuses on higher order thinking skills and the application of knowledge in appropriate ways and contexts. It is part of the desire to incorporate assessment more closely into the teaching and learning experiences, what some have termed educative assessment. The assumption is that students learn particular knowledge and skills by engaging in the assessment activity. Teaching/learning becomes indistinguishable from assessment. Of course, in moving to these forms of assessment, with their more complex and open-ended criteria of judgement, one sacrifices a substantial measure of reliability. Performance based assessment requires classroom teachers to assume responsibility for a number of complex tasks. One of these tasks is to judge the extent to which a student has performed. This judgmental task requirement can be problematic because the act of judging a performance is intricate, often qualitative. To some researchers such as Messick
(1994) and Moss (1992), therefore, performance assessment lacks validity, reliability, comparability, and fairness. Messick (1994) tells us,

> performance assessments must be evaluated by the same validity criteria, both evidential and consequential, as are other assessments . . . because they are not just measurement principles, they are social values that have meaning and force outside of measurement whenever evaluative judgements and decisions are made. (p. 13)

In addition, Wiggins (1990) explains that performance assessment, evaluation and instruction necessitates,

> . . . genuine accountability [which] does not avoid human judgement. We monitor and improve judgement through training sessions, model performances used as exemplars, audit and oversight policies as well as through such basic procedures as having disinterested judges review student work 'blind' to the name or experience of the student — as occurs routinely throughout the professional, athletic and artistic worlds in the judging of performance. (p. 25)

Lastly, the other means to assess include personal communications, such as instructional questions, conferences, interviews, journals, and logs. These may yield anecdotal evidence, which can be used to expand the dimensions of the assessment. While we can take tests that provide snapshots, we can use personal communications to link and expand these snapshots in order to produce an assessment that may be likened to a videotape of evidence. After all, "the teacher's job is to gather and interpret enough information from enough samples to be able to describe the student's performance accurately and consistently. There is no one right way. the teacher gains additional insight by assessing over time in a variety of
ways “ (Earl & Cousins, 1995, p. 31).

In summary, in order to have meaningful assessments in the classroom, we need assessment literate teachers who have professional autonomy and not just ‘teacher technicians’ acting on behalf of the Ontario Ministry of Education and Training. In Ontario, some of us have read that a teacher’s classroom performance assessment predicted achievement as well or better than external exams. “ This is no surprise, given the fact that the teacher has had an entire year to judge each student’s performance “ (Royal Commission on Learning, 1994, p. 133). Certainly, the shape and form of performance assessment currently supported by researchers such as Schmoker (1996), Stiggins (1994) and Wiggins (1993) requires teacher assessment literacy, time and peer support. Yet, is this process of developing, implementing and judging performances realistic and possible, given Bill 160 and its intent to reduce preparation time (marking-time) and the number of secondary teachers? Possibly, this study and others like it can provide useful professional development opportunities for educators in order to increase the professional competence of Ontario’s science teachers.

The Case for Authentic Assessment

Earlier, in this study, it was suggested that our purpose (why) for assessment was tied to our need to see if content (what) was learned and in doing so we limited or narrowed our assessment modes (how) as is often the case in content-based
programs (Griffin, 1998). Yet, increasingly we see a move or shift towards a more outcomes-based program where classroom teachers require more assessment literacy and planning begins with assessment schemes. This process has caused educators to plan our assessment modes (how) first and this dictates what we assess and alters our purpose (why). Indeed, often what gets assessed can be dependent on the assessment tools used and the proficiency of the teacher using them. For instance, paper and pencil tests have severe limitations because they benefit a certain learning style and may project particular teacher values, via test content (Midwood et al. 1994). They are easy to use and, therefore, overworked teachers often take advantage of these ‘shortcuts’ in spite of these limitations. Moreover, by relying solely on these tools we may inadvertently target reading skills and reduce assessment coverage to a limited number of expectations (outcomes) (Wiggins, 1993). Students, in response to these assessment decisions, often cram to learn information, and forget it once the assessment is complete. This cycle repeats once they become accustomed to the system. Combine these limitations with questionable levels of teacher assessment literacy and the tendency (in times of work overload) to take the ‘easy solution’, and we have a problematic situation.

So, what is, or should be, considered an acceptable mode of assessment? There are many critics taking aim at standardised or province-wide assessment, as noted earlier. Lazear (1994) suggests another critical point:

Multimodal testing practices based on the multiple intelligences
(including visual-spatial, bodily-kinesthetic, musical-rhythmic, interpersonal, and intrapersonal, as well as verbal-linguistic and logical-mathematical) are all viable means of testing students . . . . Students are at varying developmental stages; testing must therefore be individualised and developmentally appropriate. . . (p. 6)

Lazear, like many assessment experts, urges us to use varied assessment modes in light of student multiple intelligences and individual developmental needs. However, overworked teachers are constantly being bombarded with new demands in all areas, not only assessment. Sometimes the pressure to respond comes from the Provincial Government (Ministry of Education), Board consultants and/or Superintendents, University Faculty (courses) or actual teachers who may like to move into an area that is new in assessment, for example, math portfolios or multiple intelligences.

The introduction of new modes of assessment, curriculum and policies, without proper professional development, can create stress for teachers. This stress surfaces in many ways. For example, "teachers who have nothing more than their own individual intuition to fall back on when they face parents feel exposed, vulnerable and threatened " (Hargreaves & Fullan, 1998, p. 98). This need not be, and would not be if assessment activities were viewed as learning opportunities. One means to enhance classroom assessment, and thereby increase the learning opportunities, is to introduce more authentic assessment. The Metropolitan Toronto School Board (1995) explains:
Authentic assessments both mirror and measure learning and allow students to demonstrate what they have learned in ways that approximate or replicate 'real life' tasks and situations. Authentic assessments always involve tasks of significance and may involve criteria used by experts in the field. Authentic assessments increase the validity of evaluative judgements made about students' performance. (p.14)

Authentic assessment includes tasks that relate to real-life contexts, that make realistic demands either in or outside the classroom (Choate & Evans, 1992).

Farr and Trumbull (1997) explain two interpretations of authenticity: real learning (i.e., educative assessment) and real world tasks.

In the new forms of assessment, many have seen that the assessment opportunities themselves could reflect worthwhile learning experiences that would better capture the relevance and utility of the knowledge and skill students acquire in the domain. The more that assessment is embedded in meaningful contexts, the easier it will be for students, but particularly minority students, to demonstrate what they know and are able to do. (p.194)

So, new assessment forms need to engage students in real-world tasks and to constitute real learning that is, to be part of the educative assessment and, therefore, part of the curriculum. These means of assessment are of course, holistic rather than analytic and can only be properly conducted by adopting holistic scoring methods. Holistic scoring requires assessors to consider their entire impression and not just one singular experience. However, we need to proceed with caution: in one part of the province a task may be authentic, whereas in another part the task may not be. For instance, reading a subway
map and using this form of transportation may be a real-life task in Toronto, yet in
Kingfisher Lake, Ontario, a remote fly-in reserve, the task could be to negotiate a
snowmobile on the trap-line. Paris and Ayres (1994) add:

authentic assessment is defined by the situational appropriateness
of teaching and learning practices. The task of all teachers is to
make sure that assessment in their classrooms reflects the valued
outcomes in their curricula and is aligned with their instructional
methods so that students regard the assessments as genuine and
fair. (p. 7)

As well, authentic assessment requires the utilisation of exemplary tasks that
evolve from some level of discipline mastery (Wiggins 1990). The assessment
could attempt to measure a specific target, such as knowledge, reasoning
(cognitive domain), skills (psychomotor domain), products, or the affective
domain (Stiggins 1994). So, authentic and performance-based assessment can
be part of an analytical, or at least, a systematic approach to assessment.

Acknowledging assessment as a curriculum-embedded feature, which is
authentic, may lead to a demand that it be 'performance based'. In other words,
"the products and performances which are assessed are like products and
performances that occur in the 'real world' " (Pomperaug Regional School District
15, 1996, p. 277). So, what is meant by the term 'performance assessment' in an
authentic assessment?

Performance based assessment is a direct assessment of students' performance
in a real or contrived context (Choate & Evans, 1992). Therefore, it is necessary to point out that there are shades of authenticity, where one assessment can be viewed as more, or less, contrived than another. Performance assessments have been described as contextually rich and global in terms of authenticity, whereas traditional assessments are often maligned as they typically are skill specific and lack sensitivity to context (Choate & Evans, 1992), for example, writing a test, exam or term paper has certain limitations not found in performance-based assessments.

In sum, the purpose of this chapter was to illustrate the scope of assessment literacy in order to show just how many things there are for teachers to consider. We now know that authentic assessment is a means of collecting student performance data that reflects a 'real-life' situation and that both context and resources dictate the degree of authenticity. However, the often-low levels of teacher assessment literacy can be the biggest obstacle to credible authentic assessments. This is because assessment literacy involves an awareness, understanding and application of assessment terms (language), skills and strategies as they relate to various functions and environments. Raising levels of assessment literacy is a complex business for which some knowledge of how teachers currently assess their students is essential. Being well informed about the current assessment actions of teachers permits us to direct teacher education efforts with greater prudence. This study therefore is a way for us to find out something about teachers' levels of assessment literacy and
illuminates their understanding of assessment issues, questions and methods.

2.5 Interpretation of Assessment - Data and Evidence

To review, there are three methods for interpreting assessment data in education. One is the norm-referenced type of assessment, where the student's performance is placed or positioned along a continuum, usually relating to the performance of peers. For instance, a score of 'x' may indicate a position at the 70th percentile, meaning that 70% of the students scored below this student and 30% scored above. It should be noted that norm referencing doesn’t imply standardisation, though standardisation involves norm referencing.

A second method of educational assessment, criterion-referenced, suggests that a standard point on a scale is deemed the point at which some students may pass and others may fail. For example, if the criterion score is 65% a student achieving a grade of 64% has not met the basic criteria, and is deemed unsuccessful. It should be noted that in criterion-referenced tests no comparison is made or used, other than the comparison with the outlined and pre-specified criteria.

A third method of assessment, known as self-referenced, compares one performance/outcome to the previous score for that particular student. Researchers Earl and Cousins (1995) succinctly explain:

Teachers tend to use three different standards as reference points in classroom assessment: Norm referenced standards - comparing
performance to the performance of other people in a defined group; criterion-or outcome-referenced standards—comparing performance to some pre-determined criterion or expectation; self-referenced standards—comparing an individual's performance with his or her prior performance. (p. 27)

A well designed purposeful (why) classroom assessment scheme would employ all three methods, as each has its own merit and is useful in planning curriculum and diagnosing needs, progress and achievement. The self-referenced method of assessment may be the most relevant in terms of achievement on a day-to-day basis, as students would be comparing their performance to their own previous effort(s). For instance, to what extent can a student recall and apply Pascal's law? Using self-referenced points, a teacher and student can see achievement as results improve. It can be a challenge for the student that may positively fuel motivation. The assessment data may indicate to a teacher the extent to which a student has achieved, from one point in time to another. However, this data provides no credible means to compare students to an externally developed standard (norm/criterion).

A norm-referenced method would be useful if students or others wished to compare performances to other standards of performance. For instance if we wished to rank order scores and assign grades according to their rank order. It depends on the purpose (why) of the assessment. Current Ontario Province-wide (reading, writing, mathematics) testing programs promote these rank ordering practices as one school can be ranked ahead or behind another. Similarly, it has been the case with the Canadian Standardised Test of Fitness in Physical Education, where sit-up
performance may be compared to a Canadian normative score. Criterion referencing is closely related to norm referencing, as it is possible to compare a student's performance to some standard criteria. Hence, when developing a student profile or evaluating curriculum this mode can be used. Midwood et al. (1994) explain that criterion-referenced assessment is "... in relation to a student's success in meeting stated objectives, outcomes, expectations or criteria " (p. 407). Both approaches can be used in a standardised assessment and can be used in a non-traditional performance based assessment once possible sources of error are attended to.

**Sources of Assessment Error**

To this point we have addressed several modes of assessment yet there are many other issues underpinning assessment, such as reliability and validity. Reliability can be thought of as the extent to which errors of measure are absent from the measurement instrument time after time and validity concerns the extent to which an assessment measures what it is supposed to. (Pomperaug Regional School District 15, 1996) Teachers need to give consideration to the many sources of assessment error. Being mindful of possible assessment error means that caution is exercised to avoid assessment bias, ensure validity and embrace context issues related to ethnicity and culture. In other words, the assessment context includes many variables. These variables may even include time of day and place (location), which can impact upon the assessment outcome. For instance, a student may perform better in the morning when he/she is more alert. Assessment results may change if
the location is changed, for example, a classroom venue versus a gymnasium, central administration building or even another school can impact student performance. The change in venue could be distracting for a student, yet the classroom, being familiar, may ease assessment anxiety for a student.

In addition to these concerns, the assessor may be able to provide a rationale and interpretation of the results based on observations made during the assessment. Hence, qualitative insight augments the assessment. Given all of these concerns, assessors need to remember that diversity and context impact on the generalizability of results, that is the extent to which one score can be related to another. One source of guidance in this matter is the document: Principles for Fair Student Assessment Practices for Education in Canada (Joint Advisory Committee, 1993). Every school in Canada was provided with a copy of this document in order to inform teachers of the requirements for good assessment. Concern for equity, fairness, validity and reliability are reasons for some teachers to use alternative assessments. Yet, Farr and Trumbull (1997) point out that:

Test bias does not simply go away with the design and implementation of performance-based assessments. Potential causes of test bias include a greater reliance on language-dependent skills: more reading and writing is required for extended problems and such activities as writing explanations for mathematical solutions. In addition, performance assessments are often based on situational contexts or cultural items that may be unfamiliar to students from certain cultures. The critical thinking demands typical of such assessments, such as making judgements or expressing values, may not be compatible with some cultures' norms. (p. 62-63)
In view of these issues, many assessment experts (Stiggins, 1994, Wiggins, 1993) suggest certain performances over the term or school year should be documented in relation to standards and exemplars that are equitable and fair. This is a difficult task, open to challenge at any time. In assessment, the criteria of equity and fairness are not immediately apparent.

2.6 Documenting and Reporting Assessment - Communications

A teacher has a duty to inform students, parents, and the administration of the assessment evidence collected. The style and form of assessment information should be determined by the purpose for which it was conducted. Assessments can be used to instruct, assess, provide incentive, classify (special education), certify, diagnose, summarise, and monitor progress. As an outcome of these efforts, information is produced. The medium for the communication of this information might involve Conferences, Parent's Nights, Individual Placement and Review Committee (IPRC), Report Cards, or informal discussions/visits with parents/guardians. The communication of assessment information should also be determined by the audience, its needs and its level of assessment literacy. The relationship a teacher develops with the family of the student is often constructed via assessment results, and other forms of communication related to assessment of behaviour. Often the behavioural curriculum is equally important or even more important than the academic curriculum. The Report of the Royal Commission (1994) adds:
Parents want information: to be told, fully, honestly, in a language they can understand, and in a timely way, how well their children are progressing in school, and what teachers will do if students are not making satisfactory progress. Students want teachers to tell them clearly and promptly what they need to do in order to improve. (p. 132)

Keeping all stakeholders informed requires teachers to move beyond formal means of communication. Educators need to keep in mind that different stakeholders have different needs regarding the nature and amount of information. Even the style of communication can play a role in the effectiveness of the communication. What is often necessary is an informal means to communicate at the classroom level. This informal means can be operationalized through written modes such as newsletters, journals, agenda (homework) books, notes, scrapbooks, checklists, self-assessments, completed work, and samples and/or examples. Verbal and visual modes of informal communication include audiotapes, videotapes, telephone ("good news") calls, artwork, and electronic media (e-mail, world-wide-web). Parents and caregivers often want information on achievement, progress, behavioural challenges, special events, the needs of teachers, students and of the school. Teachers need to work to ensure the fidelity and frequency of these communications is maintained as expected by all stakeholders. In doing so, parents, who are also "concerned about common standards for assessment." (The Report of the Royal Commission, 1994, p. 132), may begin to see some consistency between teachers and across schools.

In addition, feedback from large-scale standardised assessments must be put into
perspective. The results from such assessments can be shared with Directors of Education, who direct messages to teachers via an administrative hierarchy. Recent provincial-wide testing results were released in that manner, yet the media often reported these same results before teachers had a chance to meet with parents. Teachers were left to deal with the aftermath, as confused and often enraged parents confronted teachers, administrators and Boards about low school scores. Anthony et al. (1991) explain that "a real disservice occurs when test information is used to undermine teachers' confidence in their own judgements" (p. 127). Indeed, this is what happened following a recent round of grade 3, 6, and 9 province-wide assessments. This confusion caused by imposed assessment is not, of course, a new phenomenon. In 1976, the Ontario Ministry of Education stated:

Among the most important recipients of information about student progress are parents and guardians . . . . It is understandable that some parents are bewildered — and sometimes sceptical — of what they do not comprehend and that they are concerned about the education of their children. Teachers must supply the information that enables them to understand. (p. 73 - 74)

In order to supply enabling information to parents and all stakeholders, educators must have a commanding knowledge of all facets of assessment. The proper recording of assessment information requires a level of assessment literacy. In part, literacy entails an awareness and understanding of purpose (why, what) and refined praxes (how) in order to identify significant evidence within the data collected. These stages, the why, what, and how, complete the process of assessment and aid in the
documentation and interpretation of assessment data. What remains is the communication of the assessment information to stakeholders. It is interesting to note that an analogy to the contemporary assessment paradigm would be the shooting of a videotape complete with frames of data containing evidence. Standardised tests, therefore, are but one frame of many and should be treated accordingly during interpretation and communication of assessments.

In summary, we need to know much more than we do about the ways in which teachers assess, record assessment results and communicate this information to stakeholders. At present, all we can assume is that teachers assess in a manner condoned by the Ontario Ministry of Education and Training. However, they do so in a way that is dependent upon their particular value positions (Beck, 1993). Perhaps, we can assume that educators strive for fair and equitable assessments, in accordance with contemporary thinking on assessment and in a way that serves the needs of all stakeholders. Without research data, however, these are tenuous assumptions.

Assessment data are used to inform decision-making. Educators make decisions about students, courses, curricula, and their own teaching based on the assessment results. The data supports our decisions and therefore the quality of the decision is only as good (valid/reliable) as the assessment means deployed. Low levels of assessment literacy lead to poor decisions whereas improved levels of literacy result in good (better) decision making. When we choose one method of assessment over
another we can impact both the quality and quantity of the results, marks, grades and information gathered. Often it can be argued that teachers are in the best position to judge the appropriateness of an assessment since they have the most contact with the student. So, "any talk of assessment is doomed intellectually if it doesn't acknowledge the importance of being close to the student writer and the surrounding context" (Perrone, 1991, p. 139). The teacher knows the student, his/her background and possibly the family much more than an outside entity such as a consultant. We can say that "no variable in the control of the school system has ever been shown to be as powerful a determinant of educational achievement as student background variables" (Nagy, 1996, p. 411). Thus, teachers are in the best position to assess, interpret, document, and report, due to their personal contact and knowledge of each student over an entire school year.

2.7 A Purposeful Mode of Inquiry

Assessment is revealing, often unsettling and challenging for all stakeholders. Both assessment and action research seek to provide answers which can eventually lead to transformation. In this study, the goal is not just to find out what teachers do; it's about getting these teachers to reflect on what they do, justify it, challenge it, re-think it, and try something else. Arguably, most teachers already search for and sometimes locate good practices and theory using critical reflection, as part of their personal practical knowledge building (Connelly & Clandinin, 1988). Yet few teachers take the next step of collaborative documentation or attempt to organise and
systematically examine their practice on a regular basis, as in the case of action researchers. This reluctance to document, act and revise can become habitual, largely because teachers have many more tasks than they have sufficient time. Teachers do their best, given the ever-changing contexts with which they are faced and the constraints, such as a lack of common release time and other logistical considerations (Gray & Wilcox, 1995). Teachers assess and, from these experiences, commit to memory some 'best practices'. However, they are rarely theory-driven due to a lack of time to investigate the literature and a lack of professional development provision from the Board (Hargreaves & Fullan, 1998). Therefore, it has been suggested that teachers are not usually informed by research or inclined to collaborate under current daily schedules (Wood, 1992).

Finding answers to educational problems is an often difficult process. Data from student assessment can be useful and, when used properly, can empower and enable teachers to find answers. But to become skilled and sensitive decision-makers, teachers need to interpret assessment and evaluation data. Just 'knowing' is not enough; they also need to understand. Educators need to question themselves and others about their practice and its rationale if they hope to improve and develop. Hodson (1994) adds:

Nothing should be accepted just because it is 'handed down' from the Ministry of Education. The aim of transforming the consciousness — and, thereby, the actions of teachers — begins, logically, with reflection on their current practice, proceeds through critical consideration of alternatives, and culminates in deciding on, implementing and
evaluating curriculum actions. The first requirement then is that teachers' existing ideas are articulated, analysed, criticised, compared and contrasted with others. (p. 93)

So, in sum, we know there are many ways to study assessment practices. However, if we want teachers to study their own practices, and the practices of others, in a critical way, then an action research approach is probably the best mode. Action research supports the examination and illumination of current assessment methods as teachers reflect on and discuss their assessment efforts and thoughts. Action research promotes growth and professional development as committed participants critically reflect and, through mutual support, begin to apply new realisations, values, and theory. The collaborative nature of the practical action research effort nurtures risk-taking as participants are moving forward together by informed trial and error that is reflected on in order to promote discussion. Hodson (1994) contends "... that action research is the only coherent and viable way of addressing the issues of curriculum evaluation, curriculum development and professional development/teacher education that are central to the implementation of a radically new form of science education" (p. 93).

2.8 My Assessment Position: Values, Beliefs & Biases

From the onset of this study my position was informed by practice (teaching), theory (literature) and experiences (as a student, as a teacher at conferences, seminars and workshops). My assessment praxes had developed over time and were a
consequence of my beliefs. However, I was undergoing constant change, moving along a continuum as I interacted reflexively with others.

Reflecting on how I came to be at this point, I recall that as a student in elementary, secondary and post-secondary institutions I experienced forms of assessment that left me frustrated (not having the answer at that moment). I remember feeling angry (failure to pass or recall material) and sometimes elated due to the results (high marks). These emotions were attached to certain forms of assessment. These experiences helped me to develop opinions and attitudes concerning the function (purpose), equity (fairness), and accuracy (validity) of assessment. I recall thinking that some assessment modes were functionally very unfair, such as the 'pop' or surprise quiz. Even the content of certain assessments seemed to limit my thinking and the overall assessment. For instance, the listing of definitions, completion of fill-ins, multiple choice and short answers allowed teachers to eventually judge, label and place me (sorting). Yet, this process seemed inadequate, narrow, unfair and shallow. I had a lot more information in my head but was not allowed to present it due to limited assessment modes used by my teachers. Often, even the in-class essay and examination modes seemed unfair as I had trouble getting my thoughts on paper in a manner that was clear to the teacher (assessor). To this day this is something at which I struggle to do well.

Assessment was a high stakes series of events in secondary and post-secondary classes. Often students would seek to enrol in classes solely because of a teacher's
assessment praxes. Conversely, teachers, in turn seemed preoccupied with how they were doing. For example, teachers would often see test results as a reflection of how their program was being digested and absorbed (retained). For students and teachers, assessment often undermined and eroded esteem (failure). I recall complaining that assessment was always a sneak attack, threat or consequence of something that may have or may have not occurred in class. For instance, the class might be unruly one period (day), and the next period (day) we found ourselves writing a lengthy quiz. For students, mid-term and final exams were always feared, and made most quite anxious. They were often considered high stakes due to disproportional assessment weighting (midterms 15%, finals 30%). It seemed that teachers cared more about the assessment function and content coverage (textbook) than the achievement and needs of the student. As a student we had no role to play while the assessment was developed, and as it was implemented we were workers who had a job to do (get good marks quietly).

Assessment (form and function), as I had come to know it, meant there were often teacher expectations that were not communicated, such as the level or criteria for success (exemplars). Assessment often meant guessing what the teacher wanted. The assessment process seemed foreign (adult-like) and something that was done to you rather than for you. In other words, I didn't always know what they wanted from me. Following a test, feedback was often non-existent. Instead, a number was issued, usually weeks or months later. This left me feeling unfulfilled, without
guidance; it impacted adversely on my self-image and motivation, I believe. Kohn (1994) adds:

Studies also show that, contrary to the conventional wisdom in our society, people who have been led to think about what they will receive for engaging in a task (or for doing it well) are apt to do lower quality work than those who are not expecting to get anything at all. These findings are consistent across a variety of subject populations, rewards, and tasks, with the most destructive effects occurring in activities that require creativity or higher-order thinking. That this effect is produced by the extrinsic motivators known as grades has been documented with students of different ages and from different cultures. Yet educators rarely cite the findings. (p. 39)

Therefore we need to focus on the task and not the reward (marks). This notion has guided me to advertise marks less in the classroom. Instead I direct and coach students qualitatively, using descriptive rubrics (without numbers), to do a little better each time to see what they can achieve. Early in life I found sports assessments (coaching) during practices and competitions provided me with the quality feedback (substantive comments) I missed in the classroom — thus, part of the attraction to sports for me.

As a student completing a course I was usually labelled with two, often surprising digits (grade). Sometimes this grade was more than I expected and sometimes it was not. I did not know how to appeal in high school and at the post secondary level I felt it was politically too risky. After all who was I to challenge authority? I recall that even the possibility of a rewrite was not communicated (left hidden) or it was just not available in secondary school. From these experiences I realised many feelings
concerning the function of assessment. Some teachers seemed to care more about
the forms of assessment and tried to make it more useful. I developed strong feelings
about certain teachers, peers and the system. I believe this is what motivated me to
enter teaching and focus on doing a better job of assessing.

As a teacher I wanted to decrease frustration for students as they experienced the
many forms of assessment. I was now developing and applying assessments, all the
while knowing the impact they have. I do this because it is my job. However, I try to
give substantive comments during and after assessments. I work within the system,
which mandates specific means to assess (forms), but I am also aware of the
evolution of alternative assessment modes. I have a comfort level with teacher-
centred outcome based assessments which I enjoy designing with students and fellow
staff. My comfort level has developed over a period of years. I realised I could have
stayed the same by doing what my teachers had done or I could work at changing the
forms of assessment to incorporate more alternatives and varied assessments. I
chose change.

As I became aware of contemporary assessment, via literature, and while
participating in Professional Development activities (courses, conferences, and
seminars), I was struck by the movement away from teacher-centred content-based
assessment (forms). It seemed that many educators wanted to move away from
teacher-centred modes. Somewhat uncharitably, some observers have stated that
teacher-centred modes were developed and implemented mostly for what seems to be the benefit of the teacher. Now, some teachers are moving towards student-centred assessment, where the student and teacher develop and implement assessments for the benefit of the teacher, student and parent. These modes often are more 'authentic'. I developed an interest in these alternative (see section 2.3) means of assessment and employed these in my praxes. As a result of these experiences (Ryan, 1998b), I was now firmly standing with one foot in each area (teacher-centred/student-centred) of assessment. Actually, I had most of my weight on the one foot (student teacher developed, implemented for the benefit of the teacher-student-parent relationship). During this same developmental period I became aware of many criticisms (Griffin, 1998; Harp, 1994; Perrone, 1991; Stiggins, 1994) of teacher-centred assessment. I was left with many questions which could only be answered, I believed, by fellow teachers. Hence my need to research assessment. I wanted to take my implicit notions and make them more explicit to realise personal growth that may, at the same time, help others achieve the same outcome. Also, I wanted to know what the 'state' of assessment was in other classrooms. I wanted to provide a window for myself and others interested in classroom assessment. In doing so, I believed this mode of research would professionalize assessment for all participants as we illuminated both the form and function of assessment.
Chapter 3

Action Research

Introduction

In this chapter I present a brief history and several definitions of action research. Praxis and praxes are defined and action research modes are explained. Action research roles are described, as are various conceptualisations of action research that currently exist in the educational literature.

3.1 Action Research: A Brief History

Action research has been conducted in many countries and in many fields of endeavour since the 1920's. "The story of action research is traced out almost as a family tree, with clearly identifiable descendants and some debate over who is the patriarch" (Noffke, 1997, p. 311). As a result of this growing family tree, it has achieved widespread popularity across cultural boundaries. As McLean (1995) points out, the history of action research shows several major influences.

Action research is historically credited to Kurt Lewin in the . . . 1940's . . . Ron Lippitt in the early 1950's . . . in the 1970's . . . Lawrence Stenhouse and John Elliott . . . expanded Corey's concept of action research by emphasizing its aim as adding to the understanding of the solution and the development of a theory of teaching as well as solving practical problems. (p. 4)

As a consequence of this long and varied history, in several sociocultural contexts,
action research has become more theoretically sophisticated (McTaggart, 1991).

Some major influences on its development include farmers in rural areas of Scotland and New Zealand, community development in Africa and Asia, and its use in education in North America, Australia and England (Deshler & Ewert, May 25 1995 On-line, p. 1). As well, there are several variants of educational action research that are the focus for discussion in this chapter.

**Action Research: A Definition**

By choosing to define the kind of action research participants in this study engaged in, I am hoping to minimise ambiguity. Yet, "the dictionary is full of words. They are almost all ambiguous in the sense that they have many meanings" (Adler & Van Doren, 1972, p. 97). Therefore, my task (and challenge) is to reduce ambiguity to the point where the terms I use indicate a specific, singular, contextual meaning. The term *action research* is the very foundation of this research project and, therefore, needs to be understood in a manner that communicates effectively what we did together. To ensure accuracy and increase understanding of this action research project, I have chosen to include the thoughts of Altrichter, Posch and Somekh, seminal action researchers who suggest:

The shortest and most straightforward definition of action research is given by John Elliott (1991:69), whose work has been influential in this 'movement': action research is 'the study of a social situation with a view to improving the quality of action within it'. This simple definition directs attention to one of the most essential motives for doing action research. It lies in the will to improve the quality of teaching and
learning as well as the conditions under which teachers and students work in schools. Action research is intended to support teachers and problems of practice and carrying through innovations in a reflective way. (Altrichter, Posch & Somekh, 1993, p. 4)

At this point, I would like to further consider the terms ‘action’ and ‘research’. We need to consider that most teachers undertake some action to improve their practice at many points in their career. For myself, these actions seem second nature as I am constantly attempting to improve my practice, my understanding and ultimately the situation in which my practice occurs (Carr & Kemmis, 1986). I do not believe I am alone in this.

The widespread drive to improve does not imply that most teachers are 'poor' (deficit model) educators (Hopkins, 1993). Rather, conversely, a 'good' practitioner is one who tries to achieve better results in the classroom through recursive bouts of reflection, action and revision. So, as teachers engage in teacher research, which can be described as a trial and error way of life in education, it is natural for them to wonder and reflect upon further refinements. Reflective professional development is never complete; there is always something else to consider, some other changes that can be made. Often the process of reflection is a social enterprise, as Carr and Kemmis (1986) point out:

Action research is simply a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own practices, their understanding of these practices, and the situations in which the practices are carried out. (p.162)
Most teachers will change if something doesn't work. It seems logical to make changes until you are satisfied with the outcomes, engaging in particular actions in order to ensure desired outcomes. These actions combined with reflection become praxis, the fundamental concept of action research. The action is usually aimed at improvement and, at the same time, may be intended to implement a new theory, program or initiative. The teacher acting as "the action researcher is interested in the improvement of the educational practices in which he is engaging. He [sic] undertakes research in order to find out how to do his job better - action research means research that affects actions" (Corey, 1949, p. 509).

Sometimes a teacher's action may be solely individualistic within his or her classroom and be aimed at improving some aspect of practice. Alternatively a group of teachers may have undertaken substantive actions in order to achieve better results, as is often the case in some 'team' oriented schools. We need to be reminded that "action research combines a substantive act with a research procedure; it is action disciplined by inquiry, a personal attempt at understanding while engaged in a process of improvement and reform" (Hopkins, 1993, p. 44). Indeed, it is informed action that underpins the very nature of action research (Hopkins, 1993).

Action research is, therefore, a deliberate way of creating new situations and of telling the story of who we are. Action research consists of deliberate experimental moves into the future, which change us because of what we learn in the process. (Connelly & Clandinin 1988, p. 153)
Yet, there are those who contend that action research is currently in a state of flux, with several writers (McNiff, Lomax, & Whitehead, 1996; Stringer, 1996; Zuber-Skerritt, 1996) attempting to refine and possibly redefine its nature and role. Hopkins (1993) warns, "we must, however, be aware of the problems associated with too prescriptive a framework for action and the values that are embedded within it" (p. 56). Further, as a cautionary prerequisite, we are told: "action research is not a method or a procedure for research but a series of commitments to observe and problematise through practice a series of principles for conducting social enquiry (the praxis of a social science?)" (McTaggart, 1996, p. 248). Consequently, a simple and acceptable definition may be unattainable. Perhaps action research is "best thought of as a large family, one in which beliefs and relationships vary greatly . . . . it is a group of ideas emergent in various contexts" (Noffke, 1997, p. 306). Even the Action Research International Journal (1997) has felt the need to direct attention to the struggle for a definition:

Action research consists of a family of methodologies, which pursue outcomes of both action (change) and research (understanding). It uses a process that alternates between action and systematic reflection, or achieves theory-practice integration by some other means. It is usually, though not universally, collaborative and qualitative. Its many forms include such varieties as participative action research, emancipatory action research, action science, and soft systems methodology, among others. (p. 1)

Carr and Kemmis (1986) augment the meaning of action research by pointing out three minimal requirements:
Firstly, a project takes as its subject-matter a social practice, regarding it as a form of strategic action susceptible of improvement; secondly, the project proceeds through spirals of planning, acting, observing and reflecting, with each of these activities being systematically and self-critically implemented and interrelated; thirdly, the project involves those responsible for the practice in each of the moments of the activity . . . and maintaining collaborative control of the process. (p.165)

In the project described in this thesis the subject matter was a social practice (assessment praxes in school). This social practice could be improved and our actions, the teacher’s and the researcher’s, were cyclical (plan, act, observe, reflect). As we collaboratively acted to impact assessment praxes, each of the teachers (participants) realised greater understanding and control of their learning.

3.2 Action Research: Praxes

The term praxis, used as a noun, has two meanings. Praxis in the first sense can be the practical application or exercise of a branch of learning. Praxis in the second sense could indicate habitual or established practice, as in a custom or classroom. The plural form of praxis is praxes, and this could be used to indicate several branches of learning or established practices and customs. Melrose (1996, p. 52) has explained its use within the action research paradigm:

Critical theory has regenerated the Aristotelian concept of praxis, the idea that personal theory and practice grow, develop and adapt in unison and are not artificially separated . . . . A critical practitioner is in effect a researcher into his or her own practice who develops and redevelops personal theories cyclically, as a consequence of putting these theories, as they arise, into active practice and then reflecting on that practice and the learning which has taken place.
The practices of educational assessment, or praxes of assessment, then, are something that can be potentially examined, criticised, changed and transformed. Teachers can learn by doing and by participating with others in developing their practice. Thus, science teachers can learn to assess better by engaging in assessment, participating and reflecting on the assessment, possibly aided and supported by critical friends. Such praxis is the essence of action research. This intertwining of action research and praxis (praxes) is well illustrated by McNiff et al. (1996):

To be action research, there must be praxis rather than practice. Praxis is informed, committed action that gives rise to knowledge rather than just successful action. It is informed because other people's views are taken into account. It is committed and intentional in terms of values that have been examined and can be argued. It leads to knowledge from and about educational practice. (p. 8)

Therefore, without praxis (informed, committed action), assessment may stagnate, and may remain ill conceived and narrow.

3.3 Action Research Models

As noted earlier in section 3.1, there are many ways to address the terms action and research. Definitions are often beset by controversy and debate as each researcher or group of researchers (Carr, 1995; Ebbutt, 1985; Elliott, 1991; Hopkins, 1993; Kemmis, 1980; McKernan, 1991; Stringer, 1996) propose and implement their own models of action research. Most are socially driven frameworks, which incorporate
action and reflection in recursive cycles in order to realise improvement.

Each conception allows researchers to work as practitioners or closely with practitioners to systemically monitor the issues and problems of changing practice (Elliott 1991). Four models of action research are included in Appendix R. These are labelled R1 through R5. R1 and R2 are modified versions of Lewin’s model of action research while R3, R4 and R5 represent Kemmis and McTaggart’s, McKernan’s, and Ebbutt’s models of action research respectively. Each model aims to help participants learn from experience. In this study we used the Stringer model (see figure 1, p. 72), which is illustrative of community-based action research. The model’s strength is in its straightforward ‘look, think, act’ modes which are practical, universally applicable and generally understood by most people in all communities. These traits promote comprehension and inform participants in meaningful ways. Community-based action research is often thought of as an organisation, community or group seeking to better understand and solve a problem or problems that may confront them (Stringer, 1996).

It has been suggested that:

Community-based action research . . . is ultimately a search for meaning. It provides a process or a context through which people can collectively clarify their problems and formulate new ways of envisioning their situations. In doing so, each participant’s taken-for-granted cultural viewpoint is challenged and modified so that new systems of meaning emerge that can be incorporated in the texts — rules, regulations, practices, procedures, and policies — that govern our professional and community experience. We come closer to the reality of other people’s experience and, in the process, increase the potential for creating truly effective services and programs that will enhance the lives of the other people we serve. (Stringer, 1996, p. 158)
Figure 1. An Action Research Model — Stringer (1996)
The social enterprise of community-based action research considers and embraces cultural differences. It does so via a systematic process of facilitation where participants may enjoy an enhanced life experience (Stringer, 1996), in teaching and in general. Community-based action research is then quite purposeful and in this study 'practical'. It is from this recognisable purpose that action research is often viewed as a professional development initiative (Hopkins, 1993). In community-based action research, each participant's role is of paramount importance. Participation is most effective in community-based action research when it:

- Enables significant levels of active involvement
- Enables people to perform significant tasks
- Provides support for people as they learn to act for themselves
- Encourages plans and activities that people are able to accomplish themselves
- Deals personally with people rather than with their representatives or agents. (Stringer, 1996, p. 32)

Stringer's much simplified model has benefited from earlier action research efforts. It closely resembles the action research spiral of Kemmis and McTaggart (Appendix R - 3). Each of the models offers researchers an opportunity to follow a specific sequence of events. Lewin's model, as interpreted by Kemmis (1980) (Appendix R - 1), suggests a general idea (problem) shall be followed by fact finding, then a general multi-step plan is followed by implementation (action). In Appendix R, each model prescribes slightly differing roles and actions for those involved, leading to slightly different renderings of action research. Following this there is an evaluation (revision) step. This cycle is repeated recursively. Another interpretation of Lewin's model is put
forward by Hopkins (1993) (see Appendix R – 2) which essentially prescribes a similar path, yet details specific multiple action steps that precede monitoring (implementation and effects) and reconnaissance (noting failures-effects). The Kemmis and McTaggart, (1988a) action research spiral (see Appendix R – 3), which closely resembles Stringer (1996), has a plan - act - reflect cycle that allows researchers to constantly make changes to their practice. Both McKernan's (1991) and Ebbutt's (1985) models follow a similar scheme. These models appear rigid on paper yet it has been suggested that although "action research is one way of restoring and enhancing professional confidence . . . we must, however, be aware of problems associated with too prescriptive a framework for action and the values that are embedded within it" (Hopkins, 1993, p. 56).

What seems fundamental to the models of action research is that they involve participants talking about everyday things in the life of education and unpacking them for their historical and ideological baggage (Connelly & Clandinin, 1988; Noffke, 1995). The conversation can be considered the action (Feldman, 1999, p. 141) since "it appears that conversation can play a significant role in the establishment and sustentation of collaborative action research groups, and . . . can lead to the generation of new knowledge and understanding". My position, then, is that this study derives most of its action and knowledge from participants’ conversations. At the outset, I had expected that teachers would move quickly beyond our conversations to apply new
understandings and knowledge, yet this proved not to be the case. However, like other collaborative action research efforts, the conversations themselves were the "‘glue’ for maintaining the integrity of the group “ (Feldman, 1999, p. 129), and facilitated an openness to new possibilities in assessment. They may produce significant action in the future, as the participants use their new understanding to develop new assessment tools.

**Action Research and Interactive Professionalism: Distinctions**

Action research involves strategic action (McMahon, 1999) to help participants attain a high degree of interaction, something which may be uncommon in most schools today (Sagor, 1992). The purpose of the interaction is not to give advice, as in interactive professionalism (Fullan, 1992). Rather, the type of interaction found in most action research efforts is aimed at supporting all participants as they plan – act – reflect - revise, and make public their intention to engage in research, over what is usually a set time period. As participants collaborate, new knowledge and new understandings can result. In other words, the participants generate their own critical advice! Further, action research is systematic (Sagor, 1992) and involves a series of deliberate and planned activities to solve a problem or series of problems identified by the group (McMahon, 1999). The results of such efforts are usually made public (published, presented). In contrast, interactive professionalism is more informal and casual. It is less methodical and its findings are not usually made public outside the group.
Participants in this study involved themselves in 'critical inquiry' (Stenhouse, 1975), which was planned and involved commitments that are essential for this form of disciplined inquiry. Interactive professionalism is more a way of working over the course of a career in education, a disposition to act in a particular way. It is an interpersonal style that shares some of the traits found in action research. It is also a habitual interpersonal (social) practice often utilised to solve a problem, especially in education. While action researchers do integrate action, reflection and collaboration in order to link theory (research) with practice, they often do it to transform (change) themselves, their practice or the system in which they operate. Frequently the action research mode reduces the possibility of failure and increases the chances of actual improvement. It does so by eliminating the old model of (two-stage process) research where researchers provided findings and then handed this to practitioners to implement. Participants are the researchers who produce the 'action' in action research.

The interpersonal nature of action research requires a high degree of interaction. Therefore, it seems to complement a call for more interaction within the profession (education) in order to produce change. It has been suggested that true professionalism in education requires high degrees of interaction (Elementary Teachers Federation, 1999). This high degree of interaction is a means to motivate educators throughout their careers (Fullan, 1992). This type of interactive professionalism can best be understood as teachers working in small groups in the course of planning and acting (trying out new ideas) in order to resolve problems and
assess effectiveness (Fullan, 1992). At times, this project did resemble interactive professionalism. However, it was not the intention to do so. In this study, each practitioner (participant) voluntarily entered into this project, and completed it, in order to investigate their assessment praxes and professionally develop themselves.

Images of Action Research

For each participant, personally, professionally and politically, there is a great deal of usefulness in the notion of researcher-practitioner. It can lead participants to many questions of image and cause them to ask: what are the responsibilities attached to the new title of researcher-practitioner? As researcher-practitioners seek guidance they may encounter other images of action research. Help can be found in some typology, as detailed by Zuber-Skerritt (1996), who suggests three images of action research:

Technical action research aims to improve the effectiveness of educational or managerial practice. The practitioners are co-opted and depend greatly on the researcher as a facilitator. Practical action research, in addition to effectiveness, aims at the practitioners' understanding and professional development. The researcher's role is Socratic and to encourage practical deliberation and self-reflection on the part of the practitioners. Action research is Emancipatory when it aims not only at technical and practical improvement and the participants' better understanding, along with transformation and change within the existing boundaries and conditions, but also at changing the system itself or those conditions which impede desired improvement in the system/organisation. It also aims at the participants' empowerment and self-confidence about their ability to create 'grounded theory' . . . . (p. 2-3)
The images are useful to the action researcher as they further detail possible outcomes and modes for each project. While it is generally accepted that this classification originates in the work of Carr and Kemmis (1986), it has been adopted and modified by others in their efforts to develop further conceptions of action research. However, the goals and facilitator roles for these types of action research are quite different, and each has its distinctive theoretical underpinning. A technical interest is geared towards the technical control over the natural world and is the domain of science and technology (Webb, 1996). The practical interest involves seeking a greater understanding of participants and interpreting their social practices (Webb, 1996). The emancipatory interest combines both technical and practical elements, yet aims to recreate the very system to ensure participants realise desired outcomes. The researcher's role is Socratic, in order to encourage practical deliberation of assessment and of their praxis via self-reflection. Carr and Kemmis (1986) point out:

In practical action research, participants monitor their own educational practices with the immediate aim of developing their practical judgement as individuals. Thus the facilitator's role is Socratic: to provide a sounding-board against which practitioners may try out ideas and learn more about the reasons for their own action, as well as learning more about the process of self-reflection. (p. 201)

This study reflects "practical" action research. Practical (community-based) action research happens when participants are free to speak and act as they feel appropriate. Participants aim to improve, become more effective, and professionally
develop themselves. Our study goes beyond the technical level because we hope to not only improve the effectiveness of our praxes but also improve ourselves as professionals. This study is not emancipatory, where the goal is to change the educational system, its culture and the way in which teachers perceive and function in the school culture. However, this study can be a "stepping stone to emancipatory action research in which participants themselves take responsibility for the Socratic role . . . " (Carr & Kemmis, 1986, p. 201).

3.4 Making Sense of Action Research Roles

Participant and Facilitator Roles

Whether a person is identified as a participant, facilitator or both, in an action research effort, one notion is fundamental: each person is involved in strategic actions in order to carry out collective social action (Carr, 1995). Each person enters into " . . . a process of reflection which requires the participation of the researcher in the social action being studied, or rather, that participants become researchers " (Carr & Kemmis, 1986, p. 149). Yet there is more to consider as we define the role of the participant and the facilitator in the different styles of action research efforts.

Technical

In technical action research, the participant is often thought of as an equal member of the group yet this person does set the agenda and identifies criteria for success. Carr
and Kemmis (1986) add that: "... this kind of action research ... can produce valuable changes in practice — but the value may be in the eyes of the observer rather than the practitioners themselves" (p. 202). This is because each participant is encouraged to "... work on externally formulated questions or test externally generated research in their classrooms. In essence, the purpose of the Action Research Group is the addition of new findings to external research literature ..." (Pedretti, 1994, p. 76). The technical action research effort does not concern itself with self-development of the participant as a result of working together or thinking about the experience. However, the experience may cause educators to begin more critical reflection on their practices (Carr & Kemmis, 1986). In this mode of action research the facilitator is interested in improving educational practice and is not necessarily concerned with the individual participant's practice (Carr & Kemmis, 1986). The facilitator generally sets the agenda and often provides the externally formulated question.

Practical

In practical action research, the participant's role is limited to improving effectiveness, just as it is in technical action research. Yet, in addition, it "... aims at the practitioners' understanding and professional development. The researcher's role is Socratic and encourages practical deliberation and self-reflection on the part of the practitioners" (Zubber-Skerrit, 1996, p. 2). In this mode of action research the practitioner (participant) is a collaborative member. The collaborative member
generates useful knowledge concerning some problem identified either by the
individual or another participant, yet co-operatively with other participants. Practical
action research is "... intended to contribute directly to change efforts on the part of
participants ... . the major thrust is not primarily to create generalisable knowledge or
'basic' research that is unattached to particular circumstances, but to focus the
knowledge generation on specific desired changes in a specific, often unique,
situation" (Deshler & Ewert, May 25 1995, On-line, p. 2). The facilitator works
collaboratively with the members of the action research group to formulate inquiries
and research questions. Again, this best reflects the kind of action research engaged
in in this study.

**Emancipatory**

In emancipatory action research, each person's (participant's) role benefits from the
catalytic nature of the involvement of the facilitator (group member). The facilitator "... .
helps form a reflective and critical group of practitioners. However once this group is
established, the participants take full responsibility and ownership for their direction,
[and] development ... " (Pedretti, 1994, p. 77). Hence the term emancipation.

The action in emancipatory research is collaborative, critical and self-critical inquiry by practitioners (e.g. teachers, managers) into a major problem or issue of concern in their own practice. They 'own the problem' and feel responsible and accountable for solving it through teamwork and through following a cyclical process of (1) strategic planning, (2) implementing the plan (action), (3) observation, evaluation and self-evaluation, (4) critical and self-critical reflection on the results of (1)-(3), and making decisions for the next cycle of action research... (Zubber-Skerrit, 1996, p. 84)
The role of researcher in this study can also be understood using terms, as others have, such as facilitator, associate and consultant (Stringer, 1996). The role of facilitator, associate and consultant is one of support and collaboration. Metaphorically, the role can be likened to that of a leg of a chair, where each one can be shaped differently yet the function is that of support, and together these legs of equal length fulfil a role. The role is to act as a resource and not as an expert who does research (Stringer, 1996). Flores and Granger (1996) add:

The role of the collaborator in an action research project has characteristics that seem to run against the traditional connotation of the word 'collaborator'. In the face of ambiguity, a collaborator's role is to seek clarity, not reassurance, although this may increase ambiguity. The collaborator needs to remain an individual, and not 'blend' in one cohesive unit called a 'team' or 'group'. Finally, whereas one would think that it is necessary to adopt an equalised role of collaborator for all members of our group, our discussion appears to indicate that the action research collaborator should in fact emphasise his or her own individual role as he or she illustrates power relationships that are an essential component of practice. (p. 178)

Context and Action Research

One can argue that the educational context should define the nature of assessment, and similarly, the educational context should define the nature and conduct of the action research group. Action research roles are tied to context by the very purpose of the action research. As the context or setting changes, so can the purpose of the inquiry and the way it is conducted. Therefore, the role and commitments of the participant and the facilitator are very much tied to context, setting and purpose.
To reduce and decontextualize the social world is to misrepresent the situation that is the focus of the study, argument or question (King, 1988). For example, recent concern with accountability in education has resulted in attempts to break down the art of teaching into steps that can be measured, assessed and ultimately made teacher proof. Consider the preservice teacher checklists which attempt such a feat (Royal Commission on Learning, Volume, III, p. 22), in contrast to the 'real' performance required each day in the classroom. Real teaching situations are multidimensional, idiosyncratic and constantly changing. Therefore, a research approach that uses static models, and sees problems as readily susceptible to rigorous analysis, is inappropriate. The real strength of action research is its capacity to recognise the complexity and uncertainty of educational contexts.

In addition, action research is the most appropriate research and development method to employ in education because it is holistic. It is concerned with the whole professional situation in which the teacher is located, not with some sub-set of observable, measurable behaviours. It is this holism that gives action research efforts their power and educational impact. Hodson (1993a) adds, "...We need to guard against undervaluing that which we cannot measure...", we can still make judgements, provide criticism and proffer advice " (p.143).

Assessment is a complex, multidimensional activity. You can only understand assessment practice by understanding the particular context in which it is located, and by understanding how the teachers themselves understand that context. Therefore,
as assessment shifts to personalised, idiosyncratic and context-specific methods, as noted in chapter two, it follows that action research is the ideal approach --- maybe the only approach capable of effecting significant change. An action research approach will allow this study to embrace the 'whole' culture in a manner that will produce useful professional development. This is possible because "professionals are engaged in work which influences the lives of others in significant ways, their professional development ought to be an essential component of their work lives" (Yonemura, 1982, p. 234). As such, action research demands a further series of commitments; it is a journey of self, through reflective inquiry, that is social. We do it to improve. We desire to improve praxes and understanding within the contexts in which these understandings are implemented (Kemmis & McTaggart, 1988). In sum, action research is a holistic approach to educational problems. Therefore holism and context determine the facilitator's (myself) role and, consequently, the appropriate role for the facilitator is determined by the group's composition and by the tasks in which it engages.

3.5 Action Research: Paradigms

This study is best described as a practical (improvement-focused agenda plus the promotion of understanding and professional development) action research project that is fundamentally participatory. The following section elaborates further on the "practical" and "participatory" features of our action research inquiry.
The Practical Action Research Paradigm

Practical action research has several virtues, which is why I chose to use it. For example, it is well suited to bringing about professional development (McNiff et al., 1996, p. 10) in the area of science assessment. Yet it does not attempt to "change the very system itself or those conditions which impede desired improvement in the system [as in emancipatory action research]" (Zuber-Skerritt, 1996, p. 3). In other words, it is 'practical' in the sense that it promotes change within constraints imposed by outside authorities (Board/Ministry).

Practical action research is a means to facilitate collaboration (Sagor, 1992), which is essential if participants are to gain self-confidence (Hargreaves & Fullan, 1998). It enhances understanding and may change participants' practices collectively (Rosaen & Schram, 1997), by allowing teachers to control the inquiry as the process is shared, guided and collectively directed (Hodson, 1994, p. 93). "Some see it as an overall perspective, a series of commitments to problematizing social practices (including that of action research itself) in the interests of individual and social transformation " (Noffke, 1997, p. 307).

Participatory Action Research

As well as being practical action research, this study seemed to benefit from the guidance offered in the definition of participatory action research. For instance, I was
concerned because of the number of participants (5). I asked myself if there would be increased confusion with five participants. Would confusion arise regarding our purpose, goals and mode because of the multiple interpretations? To ensure the integrity and effectiveness of the process we needed to define both participation and involvement (McTaggart, 1997). Our group discussed how "authentic participation in research means sharing in the way research is . . . practiced . . . . It means ownership, that is, responsible agency in the production of knowledge and improvement of practice. Mere involvement implies none of this" (McTaggart, 1997, 28-29). In this project each participant had 'control'. Participants collaboratively developed the interview schedule (Appendix F) and to some extent the research agenda, since the school administration had chosen assessment as a professional development focus in 1996-1997. It was coincidental that I had chosen an aide memoire (list of topics) (Appendix C) centred on assessment. Beyond these guidelines and the focus on assessment, our group had unlimited breadth and depth. As well, each participant could opt out at any point and was clearly aware of this. We collaboratively collected data (journals, interviews, group discussions, artefacts/tests and conversations); participated jointly in the analysis of data and approved the final written reports cooperatively. This process was part of our professional development agenda which tied into personal (self-improvement), political (school role), and professional (educational praxes) dimensions. Each participant had different reasons for being involved and each fulfilled the commitments as they saw fit.

Researchers such as McCutcheon and Jung (1990) have argued:
Action research is characterized as systematic inquiry that is collective, collaborative, self-reflective, critical, and undertaken by the participants of the inquiry. The goals of such research are the understanding of practice and the articulation of a rationale or philosophy of practice in order to improve practice. (p.148)

As we refined our assessment praxes both theoretically and physically the benefits became obvious. A veteran researcher characterised teacher researchers this way: "The refinement of professional skills is generally achieved by the gradual elimination of failings through systematic study . . . " (Stenhouse, 1975, p. 39). To achieve these ends group members worked via a participatory work ethic, where " . . . conversation was not only a research method used by teachers for data collection and analysis, but was also their stance toward research and a way of generating knowledge and understanding . . . " (Feldman, 1999, p. 141).

My Action Research Paradigm

I believe, like others, that action research in general " . . . is one way of restoring and enhancing professional confidence . . . [and] action research provides teachers with a more appropriate alternative to traditional research designs, one that is, in aspiration at least, emancipatory " (Hopkins, 1993, p. 56). In order to ensure that we achieved these outcomes (professional development, enhanced confidence, increased assessment literacy) our action research effort followed these principles: It did not interfere with the regular routines, it was efficient, it demonstrated commitment, it was ethical, and it was collaborative (we had a shared vision) (Hopkins 1993). Further, it
can be said that this research study "combines substantive acts with a research procedure; it is action disciplined by enquiry, a personal attempt at understanding while engaged in a process of improvement and reform" (Hopkins, 1993, p. 44).

Throughout the project, I was active in my "... study of a social situation with a view to improving the quality of the action within it" (Elliott, 1991, p. 69). I was interested in my own interactions as well as other participants as we moved towards new understandings.

Another trait of our action research paradigm included systematic inquiry, which was collective (community-based), collaborative, self-reflective, critical and undertaken by the participants of the inquiry (Kemmis & McTaggart, 1988a; McCutcheon & Jung, 1990). Action research is, after all, an exercise in participation, as noted previously, which often leads to elucidation, clarification, further communications and commitments (Carr, 1995; Elliott, 1991). The implicit theoretical perspectives of teachers’ assessment praxes emerge through discussions and observations, which are often dialectic. These means of communication produce data which are then scrutinised, challenged and refined through recursive group activities (Hopkins, 1993). However, it may be a lengthy and piecemeal process, in which group members (the community) may fight tenaciously for the views they hold because they are embedded within a wider set of values that they hold dear. These value positions are challenged and, through these exchanges, new positions may be assumed which sustain a sense of belonging in the group.
I have previously acknowledged that action research can take on a variety of forms, either individual or collaborative, and it is necessary to label our enterprise carefully. So, "collaborative forms can be collaborations between teachers and outsiders, such as university researchers . . . , or they can be collaborations among teachers" (Feldman, 1999, p. 125). This study included only teachers and was directed towards improvement. Indeed, this inquiry was undertaken to improve the effectiveness of teacher assessment praxes. Therefore, participants were somewhat dependent upon the facilitator, as is often the case in collaborative undertakings. However, because we focused on each practitioner's understanding and professional development in the area of assessment, my presence was not essential every time we met. My role was Socratic (Pedretti, 1994a) and I aimed to encourage practical deliberation and self-reflection on the part of participants, which constitutes practical action research. Our agenda was focused on assessment, yet there was a great deal of breadth to our reflections and discussions. This breadth was viewed as desirable and was enthusiastically nurtured to help clarify the praxis (reflection-action) of this action research effort.
Chapter 4

Methodology

Introduction

This chapter describes the design and organisation of this study and provides an explanation of the roles played by the researcher and participants. The care and treatment (ethics) of participants is described, as are the tools and techniques used to capture data. As well, context and further concerns are addressed.

4.1 Design and Organisation

This practical action research effort aims at the practitioners' understanding of assessment and facilitates professional development within our group (community). My role is Socratic, in order to encourage practical deliberation and self-reflection on the part of the practitioners. Our study is participatory, as each teacher acted as an inquirer to create knowledge and change specific situations in a manner that promoted self-directed growth. Therefore, our inquiry can best be understood as practical, participatory action research that occurred within a community (group).

Problem

As argued in the first chapter, secondary education is being recreated by the Ontario government without adequate knowledge of what is going on in Ontario classrooms. The Ministry of Education and Training lacks insight because there is no formal
feedback mechanism. To provide such insight there is a need to look into Ontario classrooms, to converse with educators, illuminate, critique and develop current practices that are guided and informed by teachers. Admittedly, it is too large an undertaking to study the entire curriculum, or even to consider more than one subject or component of the curriculum. However, the Government of Canada (1990) has suggested a priority, by stating:

> It is clear that improving science education is crucial to the long-term health of the Canadian economy. In a society where science education and technology are pervasive, knowledge of and facility with science is essential for all citizens. Science education must begin with a firm base in primary school but it must continue into secondary school, university and beyond. Without this ability, Canadians will have a great deal of difficulty in competing in the global economy. (p. 10 -11)

Therefore, I decided that this action research study would limit itself to the examination of science at the secondary level. Further, decisions to limit the scope of this study were linked to my concerns for the widespread confusion surrounding assessment, the anxiety of teachers caused by assessment and the current demands for accountability due to previously imposed province-wide tests. Ultimately, I chose to illuminate the assessment praxes of secondary science teachers within one science department at one school.

**Questions**

Given the sweeping changes proposed for all aspects of secondary education in Ontario, it would be advantageous to know:
1. What was the current state of assessment practice in secondary science?

2. What were participants' initial understandings of assessment and actual practices at the onset of this research?

3. To what extent did these initial understandings and actual practices change due to the illumination of assessment praxes through action research involvement?

4. What was their level of awareness of current Ontario government pronouncements and in what ways did they implement this knowledge?

As participants addressed assessment related questions we realised other outcomes that were linked to the action research mode. Hence, participants were able to illuminate and respond to the following:

5. What did participants learn about action research?

6. What other learning and professional gains were realised during this study?

7. What did I learn about action research and assessment through my involvement in this study?

**Forces of Attraction**

A popular notion in education suggests that teachers, not only in Ontario, are largely isolated and ignored by most governments (Hargreaves & Fullan, 1998). If so, it is important that teachers collectively rally together to support one another to make their views known (Fullan & Hargreaves, 1991). One means to achieve this is to form
groups (communities) of action researchers who can professionally develop themselves and supply necessary research data concerning education. The need to respond to Government rhetoric is currently acute in Ontario. For example, Ontario Secondary teachers sent a message in the latter part of 1997 by going on strike to protest the government’s behaviour and verbal assault on secondary education. Teachers want to have input; hence action research like this study can be a tool for communication and a means to educate other teachers, employers, government and the public. If this study were to used in this manner then it may be considered more emancipatory than practical. At this point participants in this study are aiming for practical outcomes such as professional development and assessment literacy. To achieve these practical outcomes participants in this study committed themselves to this research in order to make public their praxes. They also aimed to improve and transform their assessment practices, in an atmosphere of mutual support and encouragement at a time when they are seeking strength. In order to achieve certain outcomes, each of the committed and determined volunteer teacher-researchers entered into discussions with this facilitator (participant). Yet, our progress and ‘action’ was largely based on ‘critical’ (theory) conversations and to a small extent encouraged some alterations of assessment praxes. We saw “criticism itself as a rational concept: criticism can only be conducted in a community where members share a determination to learn rationally from each other” (McTaggart, 1991, p. 57). To this end we worked because teachers don’t want uninformed and unjustified criticism. However, they do seem to welcome informed criticism from fellow
professionals, who understand the realities of classroom life and are supportive of one-another.

Methods

Each action research enterprise is unique. Therefore, its methods will be "purpose-built." It will be suited to the particular situation and participants, so there is an element of "thinking on your feet" or trial and error to find out what works best. Despite the idiosyncrasy of individual action research projects, it is possible to use a checklist of criteria to arrive at some answers to fundamental questions about participation. For instance, Sagor (1992) suggests:

Each team member... answers these four questions: 1. Is our research tied to what I have to do or want to do? If the answer is no, change topics. As a busy teacher, you should commit to work only on what you consider a priority. 2. Is our research focused? 3. How involved do you want to be in this research project? 4. What will be the basis for team sharing? (p. 25-26)

These guiding conceptualisation questions can determine the shape of a study in terms of focus, commitment level, data collection, analysis and reporting. If the focus appeals to all, then their collective commitment may allow for more extensive means of collecting data. For example, deciding to use a research diary, questionnaires, interviews, photography, tape-recording, and/or video requires degrees of commitment from participants in terms of time and energy or expertise within the group. A group may have time to meet, but not to complete diaries or use video. Even deciding on whether to use one-to-one interviews, group interviews, classroom
visitations, or document analysis can be tied to a variable such as commitment. It may be that a group member is prepared to share, but only to a certain point. Therefore, the choice of methodology is tied to the fact that "essentially, action research is examining one's own practice" (McLean, 1995). Collectively, the group in this study met and considered the options, and then chose methods that were complementary to their personal and professional schedules, as outlined in the following sections.

Questions, Application and Protocol

From the onset of this study there was an agenda (action research guidelines) which I followed, and eventually, all volunteer participants followed. Early in September of 1997 I visited the school, in order to meet with the Principal, and to find out if research of this nature would even be welcome. I recall walking through the front doors scanning the area to locate a sign which would direct me to the office. As it turned out, the Principal was in the hall welcoming students back for a new year. She was smiling and shaking hands. I first stopped to ask this person where I could find the Principal. She smiled again and asked: "How can I help you, yes I am the Principal ". From the greeting alone I sensed a supportive person. I then explained who I was and what I wanted to do. I suggested that in order to illuminate the assessment praxes of secondary science teachers I would need 4 volunteers. The Principal nodded, and then stated that this year all staff were to focus on assessment as part of their professional development. I began to explain my project and by the third sentence or
so the Principal was directing me via hand gestures to the office. Once inside the office, she began to show me several action research books and articles. I smiled and relaxed in my seat and handed over Appendix I, the Principal consent form. It was signed quickly and handed back to me; I had made a connection with a supporter. From this point onward it seemed less stressful for me as the staff I was directed to also had action research insights.

Initially, I first met the science teachers individually in hallways and they agreed to participate after only a brief discussion. Later, during a more formal first group meeting in a guidance office we discussed how we would illuminate assessment praxes, promote reflection and inspire action. Each participant supported the materials I presented (Appendices A, B, C, D, G, J). Therefore, I can say that our interview questions were based on a previously constructed Aide Memoire (Appendix C). These 'Grand Tour' questions (Spradely, 1979) permitted sufficient globalness to permit teachers to describe their experiences in their own terms. For example, open-ended probes beginning with the words "tell me" and "describe a typical day or class" suggested to interviewees that a specific (assessment related) yet general or global response was expected. Additional prompts and cues allowed further depth and breadth to come out of conversations (Stringer, 1996).

As will subsequently be explained in greater detail, our group felt that the context-specific questions from the aide memoire helped to guide, simplify and contextualize the action research effort. A guideline, located in Appendix D, was used as a
resource during this research and was endorsed by all participants. A tape-recorder, researcher journal, participant observations and journals allowed further data and evidence to be collected in a collectively approved manner. In addition, data were collected from discussion groups and the general context of school visits. All participants used journals to communicate and document thoughts when possible. Journals sometimes detailed the outcomes of teachers reflecting on their educational assessment praxes. This reflection included the formulation of ideas and a few of the changes in practice (Stevenson, Noffke, Flore, & Granger, 1995). Our group suggested that this inquiry was to be viewed as a pattern of internal growth and transformation. We felt fortunate that it was recorded and documented. The multiple sources of collected data realised via multiple methods enhanced the credibility of the inquiry (McTaggart, 1997), we felt.

Participants decided how often, when, for how long, and where we would meet (Appendix J). All meetings had to be at a time when participants were free, so, this generally meant before school started or during a preparation period during the day. We had five participant schedules to co-ordinate into one schedule for action research (Appendix F). Only on a few occasions did we meet after school due to coaching activities and the like. All participants wanted me to interview them in a manner that was essentially open and involved a coherent discussion of assessment praxes. To complicate the research too much would have added more responsibilities to already overworked teachers. Hence we tried to simplify as much as possible. McNiff et al. (1996) explains that "an open interview has a starting point and an objective but no
set agenda of questions. The interviewer would be free to follow where the interviewee led as long as it was within the general framework " (p.101). The framework in this study was assessment praxes in the secondary science classroom; a guideline (Appendix D) was observed to ensure the " . . . deliberate establishment of an 'audit trail' of data . . ." (McTaggart, 1997, p. 13), and all participants were made aware of this (given a copy).

Generally, the openness allowed extensive contextual data to be collected. Five interrelated contexts or situations were recognised: The classroom, personal, social, historical and political (King, 1988). As a result, greater sensitivity was achieved towards the uniqueness of each teacher's educational situation. Indeed, King (1988) declares: " Any approach that overlooks or denies the importance of curricular contexts inevitably distorts and misrepresents the reality of curricular events " (p. 38).

4.2 Researcher Roles

My roles included being a facilitator, motivator, consultant, and participant. I found that these roles were intertwined and not distinctly separated by time or context. To facilitate, it was necessary to be flexible by changing the schedule according to participants' needs or meeting where and when participants could, in order to achieve sought after results. Also, being receptive to what was said and not immediately being argumentative facilitated communications. Participants needed support as their lives were complex enough teaching full-time. I acted as a motivator when the early meetings were held and would go to the school the day before interviews to listen to
whatever each participant wanted to discuss. By doing this, each participant, including myself, had an outlet for individual concerns and problems, and had the opportunity for some general conversation. Maintaining contact and a presence was necessary to keep our study in the forefront of each participant's mind. The study could have been easily pushed aside by sports tournaments, exams and general school activities, not to mention the two-week late November strike by Ontario teachers. During the strike I visited the picket line and listened to their frustrations. I offered positive insights concerning teaching, science and assessment. In other words, a major part of my role was maintenance of the group and fostering of group cohesion (optimism).

I also was a guide, a collaborator and researcher. As a participant action researcher I learned how to engage in action research and sharpened my understanding of assessment issues. Initially, the act of reflection on assessment praxes was awkward, as our language wasn't common or efficient. In the absence of shared meaning, our assessment language caused frequent misunderstanding. It required a great deal of probing via clarifying questions to realize a satisfactory level of shared understanding. Eventually, our meanings became shared, understood, and led to critical reflection. I also began to appreciate that "all researchers conduct research using a particular lens and that focus has a bearing in what is seen, recognised as significant, and ultimately reported " (Wideen, Mayer-Smith & Moon, 1998, p. 131).
My focus at this point was clear. It was very important to use **good interpersonal skills** to build effective relationships. Good relationships tend to support critical reflection. Many times it was necessary to offer insight, but usually just participating in a sincere and helpful manner produced desired results. Being aware of this required a 'presence of mind'. The group had to maintain a focus. We had the professional dimension, the political dimension and the personal dimension to deal with concurrently. For instance, as the collaborative participant I was cast as a catalyst, who tried to infuse motivation, energy, and make the process easier for all. I read that I should stimulate concerns by addressing the present. So I asked how things are done. I caused reflection by asking questions concerning their beliefs, knowledge and classroom practices. I was there to create new situations (Connelly & Clandinin, 1988), by assisting in the realisation of what they wanted to do, and why, and to help them question current practices. This led to concerns and reactions to some of the proposed changes and inspired questions concerning the impact of changes. For instance: Where will I find the time to develop portfolios if I lack time already? Should the introduction of portfolios be at the beginning of the semester or could it happen at another point in time? Should exemplars be presented for every task and for all levels of performance? These questions brought about further discussion but often stalled the implementation of changes in assessment practice.

As a change agent, I endeavoured to be open, fair, an active listener, empathetic, patient, and to use clarifying, probing and context-specific questions (McNiff et al.,
Generally, my goal was to build trust by demonstrating values of caring, and by being a sincere teacher-researcher. However,

action research is explicitly value laden, and our right to change the schools in accordance with our values rests on our ability to negotiate with teachers and convince them that our position is ethically sound and to the benefit of the children. (Kelly, 1989, p. 111)

What I valued seemed to be supported and augmented by the research literature I supplied during our discussions. I believe we shared values. These were exposed during the study and this led to a level of trust that was evident in the data collected. Indeed, "the researcher/facilitator is critical in establishing trust among the group members. Trust appears to be founded on the basis of knowing what to expect from others in a given situation . . . that is, some sense of security, cohesion and support . . ." (Pedretti, 1996, p. 321). I believe that we achieved trusting relationships by being supportive, committed and non-adversarial with one-another. My role was Socratic during interviews and group discussions in an effort to follow guidelines (Appendix D) as I questioned participants.

My role was most evident and defined when I contributed as a participant. For instance, I supplied resources for participants. Sometimes the material presented would cause action. For instance, newly created assessment materials would be shown, discussed and often tried in class. The group performed so well that I found myself becoming an advocate for them. I felt many times like doing something extra to bring recognition to their efforts. I satisfied this need by presenting our progress to
the school's administration and Board officials when I was invited to give a presentation.

Often I was seen as the expert who had the answers, yet I would back away from this when I sensed it. I felt it was more important that we discovered a new answer together, rather than accept what I said. I was quite aware of the power relationships and the fact that this was not a 'drive-through seminar' or workshop where you pay for answers to your problems. Instead, it was a longitudinal examination of assessment praxes in which each of us held a piece of the puzzle. There was no answer, but there were many possible solutions to consider. Weiskopf and Laske (1996) add: "Every process of change, whether at the individual or collective level, influences the interests of the other actors and creates new political constellations and thus new lines of conflict and consensus" (p. 131-132). I would agree that a certain tension existed and changed as we moved through our study, yet it was this tension that proved useful as each person struggled to articulate their thoughts and strove to understand assessment.

4.3 Participants

Initially, I met with the school Principal in early September of 1997 and discussed the proposal of this participatory action research study. Fortuitously, the proposal met the school's professional development needs, as outlined in Appendix E. Thus, this study was encouraged by the Board and the school administration. Similarly the teachers, when contacted, needed little convincing of the value of such an enterprise, especially
when they realised they would be equal participants in their own professional
development experience.

The four secondary science teachers were approached early in the first month of the
school year and a brief description of the research was presented. Within minutes,
each of the four secondary science teachers agreed, and even seemed relieved, to
become a participant in this action research project on assessment. Participants
ranged in teaching experience from 1 to 12 years. Permission forms were presented
at a second meeting and were read and signed by all participants and the Principal of
the school. A meeting schedule was developed collectively that took into
consideration participant timetables, school events and proposed a course of action
from September of 1997 until April of 1998 (Appendix F). A few changes were made
to this schedule throughout its application, principally because of the province-wide
strike that cancelled two meeting dates, October 29th and November 5th. As well, two
interviews were missed due to severe winter weather, and the odd absence occurred
for other reasons. Yet, in spite of these few obstacles, a great deal of data were
collected by participant journals, interviews, classroom visits, document collection and
group discussions.

4.4 Participants as Cases

Action research, by supporting the collection of data which is often quite removed from
"restrictive conventional rules of the research game" (Guba, 1996, p. x), is vulnerable
to criticism of its validity and reliability, objectivity and generalizability. Nonetheless,
action research uses acceptable qualitative means to gather data that eventually result in evidence. The data is built upon mental constructions and interpretations (Guba, 1996). The question, however, is omnipresent: To what extent is the data, evidence and means of inquiry accurate, truthful and acceptable?

In order to instil accuracy and fairness, a systematic approach and careful consideration of individual assessment concerns and priorities were used to ensure that each participant's assessment perspectives were given due consideration. Hence, each participant became a case study. "Case study is not a method as is sometimes assumed, but a focus of the study, whether that focus is a single classroom, institution or system. The essential feature is the case" (Simons, 1989, p. 116). Since there were four teachers, there were four case studies. The fifth case involved myself, cast in the role of action researcher, participant, facilitator, collaborator, supporter, associate and consultant. Each case became a body of knowledge well documented and, when possible, triangulated through other sources of information.

Data were recorded in participant journals and classroom observations, and all discussions were tape-recorded. Subsequently, data were interpreted and studied by all participants. Editing was completed and a final draft was fashioned into accounts. It is these accounts, viewed through different lenses that were subjected to interpretative theory. As well, reflection was used to crystallise interpretation using a framework best understood as interpretive questioning (Stringer, 1996). This included
such probes as why, what, how, who, where and when. This systematic process helped each participant achieve an illuminated and relatively coherent perspective on assessment. Together, all participants shared assessment praxes in a manner they had not experienced before. It was this 'self' building that aided the professional development process.

Validity and Reliability

In justifying action research methods, it is necessary to confront the issues of validity and interpretation. Validity is an indication of truthfulness. Does the data actually indicate what the researcher suggests in reporting evidence for claims that are made? It is difficult to say that the views expressed by individuals, in discussion with me, are the views they really hold. Could participants just be saying what they think I want to hear or things they believe may impress me? My only recourse is to examine the various forms of data and look for evidence to confirm my inferences. Also, have the views really been put into practice? Classroom visits may illuminate the answer. Therefore, through triangulation, utilising a variety of data sources, I could determine the extent of the support for claims made.

Kelly (1989) suggests:

All research is value-laden and does not entail a disregard for traditional criteria of reliability or validity. On the contrary it takes them one step further . . . . Committed researchers now make a point of stating their own position in their reports so that the reader can take this into account when assessing findings. (p. 102)
My values are best determined through the transcripts via my questions and contributions to discussions. Throughout this thesis, I have endeavoured to illustrate my values by including specific journal notes, classroom observations and document analyses. Yet, as previously stated, I believe assessment is not a snapshot or an event to be viewed once-and-for-all. Good assessment is authentic and performance based, embedded in the curriculum-in-action (Hodson, 1993). It covers the cognitive, affective and psychomotor domains in such a way as to supply the teacher with contextually rich evidence. Indeed, teachers' "real" beliefs about assessment are likely to be more evident in what they do rather than in what they say. So, we look for evidence in praxis and documentation, which is overt, tangible and often conclusive.

McNiff et al. (1996) add:

Because action research is case study research its usefulness is for others who can see its implications to their work. It is important that the effectiveness of action research is demonstrated in terms of an improvement in the quality of the lives of people whom it is supposed to be affecting. Case studies to show this are only just appearing in the public domain which show the effectiveness of action research approaches in concrete terms (Lomax, 1989, 1990, 1991; Lomax & Jones, 1993; McNiff & Collins, 1994; Pinnegar & Russell, 1995; Russell & Korthagan, 1995). (p.42)

One means to realise validity in action research is to make claims, critically examine these claims against evidence and involve others in making judgements (McNiff et al. 1996). Guba (1996) explains:

That action research may not conform to conventional criteria of research rigor is much less important than that it takes a more democratic, empowering, and humanizing approach; assists locals in
extending their own understanding of their situations; and helps them to resolve the problems they see as important. (p. x)

Action research is a context-specific activity, as is assessment. Therefore, the issue of validity is related to the specific context. Indeed, "validity claims can only themselves be established discursively (that is, through discussion, debate, etc.) but that certain conditions need to prevail . . . . This means that everyone must have equal chances to assert and challenge, to put forward reasons and arguments " (Grundy, 1996, p. 113). In this inquiry, our claims revolved around issues related to what was assessed, how it was assessed, why it was assessed, and who assessed it. Claims and statements were critically examined via a series of recursive discussions focused on assessment. For instance, the absence of a particular mode of assessment in these secondary science classes shed light on the question: How were students assessed? All participants considered why this mode of assessment was not used and how they could use it in the future. All participants reflected upon these discussions and then further addressed the issues related to this mode of assessment in science. Hence participants' views are valid to the extent that they illustrate the claims made and represent a 'version' of what was discussed. It was an authentic and fair critical discussion. However, there is also the issue of plausibility, which requires readers to decide for themselves whether or not the data are authentic.

4.5 A Statement of Care and Treatment

Like all action research, this research entailed responsibilities and questions
that were ethically problematic. McNiff et al. (1996) explains:

There are important ethical considerations if you intend to publish information that involves other people. It is particularly important to ensure confidentiality and anonymity in action research and particularly difficult because action research by definition is about you and therefore others can identify themselves and each other. Being completely open about the research from the beginning pre-empts many problems that arise when action researchers have been less than open . . . (p. 26-27)

All material destined to be published in this study was edited by each participant, case study names were changed and all intentions were shared with all participants. As well, most universities have well-developed ethical review protocols. The OISE/UT protocol was completed by the principal investigator and covers all aspects of the research study. Intentions for the data collected and informed consent were covered in the OISE/UT ethical application (Appendix G), which included a statement of intent, an ethical review protocol, an ethical review certificate and a statement from committee members. Each step in the ethical review was a safeguard for participants and administration, which served as a legal form of prudent care. This care can then be demonstrated in a certificate, which is granted once all parties understand the dimensions of the research. Committee members, researcher, University ethics committee and research participants are involved. This process is critical to ensuring an ethically correct pathway.

Additionally, there were several guiding principles, which were ethically bound to the action research process. Winter (1996) summarises the key elements as follows:
-All participants must be allowed to influence the work, and the wishes of those who do not wish to participate must be respected.
- The development of the work must remain visible and open to suggestions from others.
- Permission must be obtained before making observations or examining documents produced for other purposes.
- Descriptions of others' work and points of view must be negotiated with those concerned before being published.
- The researcher must accept responsibility for maintaining confidentiality.

The research data reflected what was illuminated, observed and recorded, yet it needed to be edited by participants to ensure the accuracy of researcher recording, interpretation and documentation. Each participant received copies of interview transcripts with the understanding that they were to edit as they felt necessary, and that together we would discuss any proposed changes. Even as the thesis began taking shape, a complete copy of each teacher's case study was provided so that they could proof read. If changes were necessary, we made them collectively after discussing the issues. All information was provided by participants voluntarily and revised collectively at each stage of the inquiry. It was through this process that we became aware of own perceptual biases. This awareness has been termed reflexive critique (Winter, 1996).

During our discussions I pointed out that some of the things the teachers were doing didn't seem to match what they said they were doing. Indeed, some practices contrasted sharply with assessment literature suggestions. This point was made to precipitate re-thinking and stimulate teacher learning. Newman (1991) adds:
... Becoming a reflective practitioner makes it both possible and legitimate for me to acknowledge the mistakes . . . [and] by exploring teaching enterprises that seem not to be working I am in a position to discuss what has happened, or is happening . . . so we can allow more effective learning to occur. (p. 356)

My observations needed to be communicated to participants in order to balance the discussion with praise and criticism. An equitable amount of each was very much a part of our agenda for ethical research. It ensured trust and open communications, which were vital to the success of the enterprise.

Sensitivity was required at all times to nurture trust and maintain an ethically sound stance (McNiff et al. 1996). For instance, access to educational buildings and staffs were negotiated and approval was confirmed via documentation at every step. Yet it was difficult to cover every ethical problem with informed consent, and this was an inherent limitation of the process. Frequently, verbal permission was granted by participants at particular points in the study, so at least a sense of ethical approval was given. All evidence, some of which was not sought, but came to light in the course of carrying out the study, was examined carefully. However, the evidence needed to be within the negotiated access, permission, and approval boundaries (Burgess, 1989).

Openness is the key to lessening the impact of an unfamiliar person in the work environment. This can be done by proactive explanatory communications. This is important in the formation of ethical relationships within what Noffke (1997) has suggested are the "interconnected spheres of the professional, personal and political
dimensions " (p. 333). For instance, being forthcoming, sincere and leaving no questions in the minds of participants concerning motive or treatment of data in or outside of school. Consequently, on the first day of our study I made it clear that: " my sole purpose was to support and facilitate growth and professional development in the area of assessment and no information would be communicated outside the group unless all participants approved of its release" (October 1, 1997, p. 1).

4.6 Tools and Techniques

The activities in this study can best be understood by recalling that each participant looked, thought and acted recursively throughout the process of this action research study to illuminate assessment praxes. Stringer (1996) further explains,

The 'look, think, act' routine is but one of a number of ways in which action research is envisaged. Kemmis and McTaggart (1988), for instance, present action research in terms of a spiral of activity: plan, act, observe, and reflect. Different formulations of action research reflect the diverse ways in which the same set of activities may be described, even though the processes they delineate are very similar. There are, after all, many ways of cutting a cake. (p. 16)

These phases (looking, thinking, acting) within the routine were augmented by the use of a tape-recorder and journals which further captured assessment observations, thoughts and actions, and ensured satisfactory triangulation. It is standard practice to tape-record sessions to produce transcripts that may be further examined by each participant. This practice enhances and promotes reflection. It is through these
transcripts and journal entries that participants enter into dialogue around what may be opposing value positions. These dialectic events are expected and encouraged, and the tone of these discussions is sincere, honest and centred on mutual respect for one-another. Thus, participants learn by communicating and personal reflection (Newman, 1991). As learning and transformation take place, 'spiralling' (Carr & Kemmis, 1986) (looking, acting, thinking recursively), a feature of action research, can produce a great deal of data. This data are looked at, acted upon and often leads to change (Stinger, 1996). The cycle of thinking, looking and acting (Appendix B) is repeated recursively.

Journals were used to achieve two outcomes: first, to communicate and document thoughts about action research; and second, to preserve the thoughts of teachers reflecting on their educational assessment practices. In addition, a third aspect involved my reflections on the process and results. It can be asserted that the action research cycle was going on at two levels. First, teacher-participants looking, thinking and examining their assessment praxes. Second, my own recursive examination of activities related to my action research project. The common ground was the context, relating to the context of all participants, and the focus, assessment.

As indicated previously, the first level of action research involved the teachers in looking at their current assessment praxes, thinking about the rationale for these actions and for alternatives generated in-group discussion, and examining their effect in the classroom. At the second level of action research, 'looking' involved the gathering of data which included contextual descriptions; 'thinking' included exploring
and analysing what was happening in the research site(s); 'acting ' comprised the thesis (report), its implementation (usage) and evaluation (recommendations).

Analysis of data collected through reflection was in itself a process. The reflection process, carried out by all participants, was the analysis, which led to theorising and the transformation of understandings of assessment praxes. (Stinger, 1996) Within the transcripts and journal notes, evidence that supported changes in assessment thoughts and practice was identified and described. Winter (1996) explains that "action research is seen as a way of investigating professional experience which links practice and the analysis of practice into a single, continuously developing sequence" (p. 13). Thus, data collection and analysis were not separate acts; they occurred simultaneously. Some early action researchers (Corey, 1949, Taba & Noel 1957) have treated the act of data collection and analysis as separate entities. Barnsley and Ellis (1987) suggest an acceptable contrast in method as they explain: "data analysis can begin while the research is in progress as well as after the data has been gathered " (Part V - p. 24).

As the data were mounting, I began to skim the collection and commence the task of reflecting on what I had sensed. Further reflection brought to mind key concepts and words that supported these concepts. I use the word 'concept' to describe something that, to my mind, is unambiguous. The key concepts were used to assemble a matrix. I believed that the conception of data analysis articulated by Sagor (1992) suited me best:
Data analysis can be most simply described as a process of sifting, sorting, discarding, and cataloguing in an attempt to answer two basic questions: What are the important themes in this data? and (2) how much data support each of these themes? (p. 48)

My assessment themes became key terms and were used on the horizontal axis of the matrix shown in Appendix H. These included: What, Why, Who, How, Time, Isolation and Views. The 'What' meant: What do you assess? The 'Why' meant: Why do you assess? The 'Who' meant: Who completes or develops the assessment? The 'How' meant: How do you assess? The 'Time' indicated that some mention or inference was made to time as a constraining feature of assessment praxes. 'Isolation' indicated that some mention or inference was made to teacher isolation as a feature of assessment praxes. The 'Views' term indicated that a view had been expressed repeatedly and strongly.

On the vertical axis, I had sources of data (group discussion, one-to-one discussion, journal, classroom visit, informal communications, and documentation). Each key concept was given a colour code. As the data were skimmed, sifted, sorted and a linkage to the key concept was found, the data were highlighted in the corresponding colour. As well, in each box of the matrix, co-ordinates were noted, such as the date and page number. So, if I were looking for data concerning the 'what' (key concept - horizontal axis) of assessment praxes, I could go down the column to locate the source (group, 1:1, journal, document, visitation, informal note). Located in a specific
matrix box would be the source's location by date and page number, thus enabling rapid location and recovery of the information.

4.7 Context

This study addressed context as an integral factor in the determination of each teacher's practice and a critical element of the mode of inquiry. Stringer (1996) explains: "... Action research ... provides a process or a context through which people can collectively clarify their problems and formulate new ways of envisioning their situations " (Stringer, 1996, p.15). This study attempted to clarify and refashion praxis by reflecting on several contexts. These included, but were not limited to, five interrelated contexts: the classroom (everything within the four walls), personal (artefacts and thoughts of the participant), social (interpersonal linkages), historical (information prior to the observation), and political elements (issues related to governance) (King, 1988).

Contextual information came from observations and reflections upon classroom experiences, participant discussions (interviews) and document examination. These activities led to a realisation that we held many common values and beliefs. For example, each participant understood that the term 'classroom' included the contextual elements of the teacher, books, materials, content and students (King, 1988). Context, then, was understood as a term encompassing these elements. However, the context of education also has many distinct sub-cultural elements, including language. For instance, Ontario education has a language built upon the
Ontario Education Act, interpretations and applications in the forms of programs and the like. Indeed, throughout the act, terms such as teacher, school day and secondary school are defined. Furthermore, in educational discourse, acronyms abound, such as the I.P.R.C., I.E.P or I.P.P., T.A. or E.A., V.P., SP. Ed., O.S.R., S.R.R., L.D., P.D.D., and so on. This language is part of the educational context into which new teachers are inculcated, from day one, in preservice, but to the laity it can be a barrier, a point of separation between the 'public' and the profession.

Hence we need to be reminded that, "context is not communicated by a product alone" (Farr & Trumball, 1997, p.271). It cannot be. Because classroom context and for that matter the school culture is too multi-layered, too overwhelming, as Stevenson (1995) concludes:

... classroom or school context is too complex to be described in only one way: Multiple events are happening and there are multiple ways of interpreting those events. Second, theories (and the ideas derived from theories) enlarge our vision by directing our attention to important aspects that would otherwise go unnoticed . . . . (1995, p. 201)

Yet, in spite of this understanding attempts have been made to bring the context to life by describing elements that contributed to it. A goal throughout this study was to present features in such a way as to make the reader feel as though they were there or at least increase their understanding of the multitude of situations that contributed to various claims and outcomes.
Chapter 5

Action Research Chronicle

Introduction

Chapter five contains a record of events that details the evolution of this study. Entry, group formation, and specific background information that characterises participants is included to provide context.

5.1 Entry

From the onset of this project I had a feeling that I would be somewhat of a unique entity as I appeared on the secondary school scene. After all, I was a teacher on an unpaid leave completing a doctorate at a time when most teachers were mired in strike discussions due to the political upheaval in Ontario during the early part of the 1997 school year. Teachers were fighting for pay raises and a fair workload and I had chosen to do more work with no pay. I had the greatest respect for secondary science teachers since I had been one myself. I believed I understood their current working environment, stresses and to some extent what needs they might have.

I understood how teachers maintained a professional decorum at school in order to groom the next generation and maintain a professional atmosphere. After all it has been suggested that: "... 'teaching' involves passing on of knowledge, skills, or modes of conduct in such a way that the learner is brought to understand and evaluate the underlying rationale for what is presented to him " (Peters, 1966, p. 261).
I read how each teacher should inspire and motivate students in spite of distractions.

I, myself have faced these same challenges that Peters (1966) explains:

His task as a teacher is not only to convey the importance and excitement of science and to display gradually how the world looks when revealed by the searchlight of scientific theories; it is also to initiate others into the procedures by means of which such assumptions, which include his own, can be assessed . . . . a teacher must be both an authority and teach in such a way that pupils become capable of showing him where he is wrong. The teacher is an agent of change and challenge as well as of cultural conservation. (Peters, 1966, p. 261)

My approach then would be to find out if participants in this study do allow students to question their beliefs and to what extent. If they do, then, do they attempt to motivate their students through the critical questioning of science? If they do, what, if any role does assessment play? Do they present themselves as authorities yet allow students to show them they may be wrong? I need to acknowledge participant's roles in our group, in the classroom and in the school (context), while gradually illuminating assessment praxes. Acknowledgement would hopefully bring about greater empathy and understanding as participants could slowly build enhanced trust with one-another. In doing so, discussions would present challenges via critical questions, all the while commenting on, and probing assessment knowledge, skills and modes of conduct. I wanted to dig deep. I wanted to explore personal, professional and political opinions. My questions were topic focused (Appendix C), honest, intense, critical and often skirted the political correctness one might find on any given day at school between colleagues. We discussed this approach openly and sincerely later in our first group meeting and this was appreciated and understood over the next 14 group meetings.
My questions were aimed at clarifying, probing the context-specific elements of assessment (Appendix C) and each participant soon followed suit with their own questions and responses.

Since I had introduced this manner of questioning from the onset and explained what we needed to do (ethics) it seemed to facilitate the uncovering of beliefs, values, and data that could address research questions. I channelled my energies as I presented myself, assessment and action research as I had come to know it, all at the same time. Reaction to this process can be seen in the transcript excerpts, journal entries, assessment tools and finally in the following sections of this work.

I felt the full weight of my responsibilities. I had to facilitate, support and guide a process. It was a professional development initiative that lasted seven months. It consumed the better part of a school year and participants were free to drop out at any time. I wrote in my journal day one.

I hope everything works out and if someone drops out I will take it personally. I have all my eggs in one basket-so-to-speak - 'great' - is this really what I want to do? (October 8th, 1997, p. 1)

I could not predict anything. I could not predict the degree of what eventually was realised or the way in which people would view my efforts. It was very stressful personally. I could not predict the rate of each person's progress towards a better appreciation of assessment nor the degree of need I might uncover. Would participants express anxieties and uncertainties openly or try to hide these? Would
my approach cause problems? Would my approach stimulate and challenge participants enough that they might complete the study? I would soon find out.

5.2 Group Development

Entry to the school was facilitated by the positive attitude of both staff and administration. I met with the Principal and, following the proposal presentation, a consent form was signed (Appendix I) and I was informed that teachers were to embrace an area of assessment as part of the school's professional development program. This was to be carried out by teachers as best they could. Since this study would meet their needs, it appeared, although coincidentally, that this study would be embraced and encouraged by the Board and school administration. So, when contacted, the teachers needed little convincing of the value of such an enterprise and individual consent forms were signed (Appendix J). I was elated and less anxious now.

Each of the four secondary science teachers was approached early in the first month of the school year. Participants ranged in teaching experience from 1 to 12 years. There were two male and two female science teachers. Generally, few interruptions to the action research schedule occurred, due to the fact that all participants lived within a short commute of the school and a positive attitude was maintained throughout the study, which lasted three seasons, fall, winter and spring 1997-1998.
5.3 Participants

The participants included four Ontario secondary level science teachers within one science department at one school. A fifth participant was myself, who had previously taught science at the secondary level. I had taught, by this point in time, for 12 years at various levels including college, secondary and elementary school, and I was currently on an educational leave to complete this action research study and the doctoral degree at the University of Toronto's Ontario Institute for Studies in Education. Three of the five participants were from central Ontario and two were originally from the East Coast of Canada. There were diverse characteristics in the form of qualifications, experience and position that were contextually noteworthy.

Cal

Cal began his education in southern Ontario, where he attended elementary and secondary school. Cal then attended the University of Western Ontario to study science in the Bachelor of Science (B.Sc.) program. After his first year, he transferred to the Physical Education program and graduated with a Bachelor of Physical Education (B.P.E.) degree in 1985. Cal then attended the University of Windsor and completed a one-year Bachelor of Education (B.Ed.) degree in 1986. He has general science and physical education teaching qualifications at the intermediate and senior levels. Cal had an interesting reflection concerning his year in teacher's college that was similar to other participants in this study.
When I went into physical education I knew I wanted to be a teacher and I went to Windsor for the B.Ed. You needed above an 85 to get in. I only learned when I went to practice teach. I didn’t learn anything from the in-class; we spent a week on ditto machines, how to make a ditto and by the end of that year they had been outlawed so you couldn’t use them anymore. It was a total waste of time — computers, physical education and science courses. I graduated in 1986. (February, 4th, 1998, p. 1)

Cal has now been teaching for 12 years. He currently teaches science at the secondary level and has taught a number of other subjects in his career. Cal has also been an active coach involved in extracurricular activities during his years on staff. Cal has worked on this staff for all of his 12 years.

Bob

Bob was the first science teacher to join this study. Bob was educated in rural Nova Scotia and attended elementary and secondary school there. Upon graduation from grade 12, he attended St. Frances Xavier University in Antigonish, Nova Scotia, studying for a Bachelor of Science (B.Sc.) degree with a major in physics and a minor in math. Bob then attended the Faculty of Education at St. Francis Xavier University and graduated with a Bachelor of Education (B.Ed.) degree in general science at the intermediate and senior levels. He was then hired by his present employer and has taught there for 6 years. After 3 years of teaching, Bob completed his physics specialist additional qualification course. He has many assessment concerns. For instance, Bob pointed out during our October 8th, 1997, one-to-one interview:

During the semester, I find inevitably if I was asked by a teacher or parent or by that student, how they are doing in the class, I think I fall
back to their marks. I find it very difficult to get beyond the marks to determine what their understanding level is in the course. I think that differs from the class. I think I would know if the class understands a concept. But, I think the individual student who has all 70 percent grades, they understand. But, if they're all 40 percent grades, then they do not understand. (p. 3)

Bob had a sincere interest in understanding his assessment praxes and had many questions and contributions to make to our group. Bob is a leader. He is the Head of the science department and also performs duties as a guidance person at the school. He is the only teacher teaching senior physics in the department. He has been actively coaching sports teams at this school for each of his 6 years. Initial contact, in September, allowed Bob an opportunity to explain not only his position, and plans, but also the science department's past, present and future direction.

Jan

Jan was the second secondary teacher whom I met. I met her in a hallway early in the first week of September. She is also from Nova Scotia and had been educated there during her elementary and secondary years. Jan attended St. Francis Xavier University and studied chemistry as a major, together with math. She graduated with a Bachelor of Science degree (B.Sc.) and attended the Bachelor of Education (B.Ed.) program at St. Francis Xavier University. She graduated in 1992 with general science and math as her teaching qualifications and was hired to teach at a central Ontario secondary school, where she has been since. Jan has taught science since being hired six years ago and is active coaching extra-curricular sports. During this 1997-
1998 school year she taught mostly chemistry at the senior levels and general science at the intermediate levels. Jan had a sense that she could improve her praxes through our action research group. Her learning seemed to come from dialogue with others, as suggested in this October 8th, 1997, excerpt:

I think at times when I test, sometimes, parts of my test, at least when I first started out, I found that they were very much rote memory. List the six steps of this, do that, and I didn't find that I was encouraging enough application. I have found that in the last couple of years, I think Bob's kind of encouraged me to take that direction. It's only through conversations; it's not from looking at my tests and saying this is all rote memory. It's just from hearing him speak of his testing methods and how he likes to throw in the practical applications. So that you get a drift of where the kids are, so, I guess he has sort of encouraged me to change my testing methods. (p. 3)

Given the notion of isolation in teaching (Hargreaves & Fullan, 1998, Fullan, 1991, Earl & Cousins, 1995), it is particularly interesting that Jan speaks of colleague collaboration and dialogue as the force which can, and has, moved her to change her practice through self-reflection.

Pat

Characteristically, Pat was located in a science preparation room busy putting together her lesson for the day. Pat had been hired close to the beginning of the school year, therefore she felt "under siege", yet was kind enough to listen to my proposal and enthusiastically signed on for the duration. Pat was educated in central Ontario during her elementary and secondary years. She then attended the University of Toronto to study science, graduating with an Honours B.Sc. degree before
attending the Faculty of Education at the University of Toronto, graduating with a Bachelor of Education (B.Ed.) degree with intermediate and senior teaching qualifications in mathematics and general science in 1997. Pat was hired in August of 1997, and has taught mostly intermediate science. Pat wanted answers and was eager to explore assessment praxes, as this passage from an October 8th, 1997 one-to-one interview illustrates.

I'm still not happy with the questioning. Until they write the answers, I don't really know how they interpret my question. My question might seem to me extremely straightforward, but then when I go through I find that as I mark the test, I revamp the questions for the next series of tests. I'm getting there, I like the progress that I am making and they know that they are going to get more applicational. [sic] The first two tests I purposely made extremely "remember, regurgitate", because the language of science, like any other language, you have to learn before you can apply. So I wanted them to start doing that. It is a sit down and learn it type of action and it just takes discipline. But now, during the 3rd or 4th test, I am getting into more applicational. What I have done, they don't know it yet, they are getting the test tomorrow, we went through applicational [sic] in the class, we had discussions and debates. I am using those same questions on the test; the same questions because I want them to remember what they have talked about in class, so that, for the next test, they remember that, "yes, she used the same questions". I won't use the same questions, but they know the manner in which to attack the questions and also if you are listening in class. So social skills and dynamics are worked into it. I like what I am doing; I still would like about four more days added onto each week so that I can do more. Right now I am keeping my head above water by about two weeks, but it takes more than that to get a good assessment program put into place. But I've got lots of years ahead of me to put it in and I have a lot of good ideas. Right now I am doing okay. It is a little more pen and paper than I would like, but I do not think they are up to the group work yet. (p.1)

Pat brought so many issues and questions forward that our group often overflowed with discussion. It was fortunate that we had a person like Pat in our group. She provided that steady pressure, to want to know 'why', or ask; 'How' do you assess for
that? Being a first year teacher, Pat brought forward a perspective not always available to teachers with years of experience.

T.R. (Thom)

Thom began his post-secondary education at Lakehead University in Thunder Bay, Ontario. He entered the Honours Bachelor of Physical Education Program in January of 1981, completing it in four years. His fifth year at Lakehead was spent completing the one-year Bachelor of Education Degree in Science and Physical and Health Education. Upon graduation he taught for a year with Confederation College (Thunder Bay) and then completed a Masters Degree in Education at the University of Saskatchewan. Thom has taught for 12 years. For four of these years he taught Secondary Science and other subjects, and for the last seven years he has been teaching at the elementary level with Trillium Lakelands District School Board in Southern Ontario. At present he is completing a Doctoral degree at OISE/UT in Toronto. In spite of his experience and education, there were many doubts about role and process.

One day I'm teaching and the next day I'm at student at OISE. On the next day, I'm a facilitator in an action research study at a secondary school. It can get confusing. Refocus, I'm on an educational leave, which means, I must take charge of my agenda and make decisions. Being truly self-directed is quite a change from the teaching role that dictates where, and when, with whom, and for how long. The freedom may be akin to retirement, I guess, yet, it is something that is unpredictable. It is at times intimidating as everything is up to me. Luckily, I have time to seek guidance from my action research books and really just being at the research site is comforting since I'm in an environment and context that I understand. I need to establish myself
and that will take time. Can I do it? (Journal Entry - October, 1st, 1997, p. 12)

5.4 Settings: Context

This study was confined to one secondary school. It was situated close (500 metres) to a typical southern Ontario major highway on the one side and a small city neighbourhood to the other. The main building was set on a 20-acre site, which shared athletic fields and a track with another school. Like many schools, the grounds were home to three portables even though the school structure had been recently constructed.

All one-to-one interviews were held in classrooms or offices, as were group discussions. The school had a capacity of 800, however there were 660 students in attendance from grades nine to thirteen. The school was recently built (9 years old) and therefore had a sense of newness about it. The original shine was still present on many of the building materials. Like many of the schools built in the nineties it had design features that were spacious (ceramics, skylights, foyer, halls) yet warm (plants, earth tone colours) at the same time. A large yard with playing fields surrounded the school. Both were well maintained. A large parking lot and an absence of graffiti gave me a feeling of calm. The office was brightly lit, spacious and relaxed. The staff room was as large as any classroom and nicely equipped with a kitchen, television and comfortable furniture including several tables’ staff could either dine at or work. The staff room was large enough so that several people could participate in different
activities yet not offend one-another due to noise or level of activity. The staff room was close to the comfortable clean cafeteria so that staff could access it quickly and easily when necessary.

Our school consisted of two, one-level wings, a large hardwood floored gymnasium with stage, cafeteria, administrative area, staff-room and workroom. There were at least 16 classrooms (8 in each wing), a library, two technical shops (wood, auto), a music room and computer lab. Of the 16 classrooms, three were science classes. The overall layout looked like a 'u', with the bottom of the 'u' housing administration, gymnasium, stage and library. There was a large entrance foyer with ceramics, planters and high ceilings. There was also a chapel, guidance and special education offices. There were at least 40 staff members who were mostly young (first 10 years of practice) and seemed quite happy as we exchanged greetings occasionally.

Two of the science labs were large and contained customary stools surrounding two large black laboratory tables approximately 1.5 metres wide and 6 metres in length. At the front of the class was a similar teacher's black laboratory workbench area with gas outlets and sinks. The walls were painted cement block and there were two large blackboards. The two larger science labs were connected by 2 work/prep/office areas, which held fume hoods, teacher desks and supplies. The third science classroom was actually a smaller room that had been altered to accommodate a science class and it was located in the other wing of the school.
Our group meeting either took place in a science classroom before school or in a guidance office. One-to-one interviews took place in guidance offices (Bob), physical education offices (Cal), and science classrooms (Pat, Jan). On most occasions I would enter the school, visit the office to make myself known to the administration on that day (yet they had copies of our schedules) and then attempt to locate participants, since their movements and locations could change suddenly and often in response to school events. From September 3rd (consent forms) until the end of April I visited the school often (usually 2 full days per week and sometimes more). Many adults who filled the building each day saw me as part of the school’s staff.

One-to-one interviews were relaxed times as we discussed assessment in terms of the topics I had identified and the priorities participants had. The discussions were free to go in any direction and were usually 30 minutes or less. All exchanges were recorded on a small tape recorder I carried with me. Of course, my actions concerning the use of the tape-recorder, at any time, were approved and supported by all participants. Indeed, "action[s] must be decided carefully and prudently: members must not only agree to abide by democratic group decisions, but also to underwrite them by their free commitment to decisions" (Carr and Kemmis 1986, p. 148). So, as I watched participants teach, on several occasions, I made notes and often recorded my thoughts on tape. It was this feeling of freedom that created momentum for participants, I believe. For instance, Bob wrote: I like to open up and speak my mind when I can expect support and understanding from group members it helps me regain my energy (October 10th, 1997, p. 10). Generally, each time I met a participant it was
quite exciting for me and I sensed that each participant was grateful for the time I took listening to and reflecting on their perspectives. Our group meetings (Appendix F) were also exciting, numerous (14+) and seemed to energise one-another.
Chapter 6

Cal: Past and Present

Introduction

Chapter six contains several images of Cal as participant and teacher. It is through these images that emerging themes are illuminated and some answers to a few of the research questions are found. For Cal, the major themes were experience, influences, targets, modes, time, isolation, change, autocracy and fairness. Often, the discussion of assessment praxes addressed one of our research questions directly, other times indirectly. In the end, our discussions led to a series of assessment transformations; meaning that I believed some change in praxis had occurred. My review of these transformative events provides a final section for this chapter.

6.1 Experience

Cal’s efforts to undertake research into a practical problem (assessment) caused him to change some aspects of his teaching. Cal developed greater understanding because of his teacher-researcher efforts, however his knowledge of action research as a means to improve his praxis facilitated these changes (Elliott, 1991). His understanding was nurtured and supported by careful and thorough reflection that gave way to action. Cal and I met in his office, which was adjacent to the gymnasium, since he taught both physical education and science during 1997-1998. Each time I arrived in his office I got the sense that he was not ready for my arrival. His desk was
piled high with student assignments (marking) and only one chair, his, could be found. On the first day I borrowed a chair from the library and this became my routine each time we met. We usually began by reflecting on his actions relating to current school events, the last class or the failing of the system. Cal, who approached most activities with a sense of humour, wrote:

Hello journal I'm Cal - I hope you can read these scratches Mr. T -- Anyway, I need more time, yes — more time in my day is well known to all (Mr. T) as he must think I'm forgetting — I'm not, its just that we're busy, busy, busy. Some day I'll get organised maybe I need shelves in my office, too much stuff to look at and this action research would be great if I had more time to do it. Assessment is our p.d. [professional development] focus this year so I'm looking forward to the next few meetings. This journal will be very short but it will be yours. (October 8th, 1997, p. 1)

Cal's journal was short (42 pages) but it was quite full of useful insights. The tension I sensed from the beginning was due, I believed, to the low morale caused by government attacks and a possible strike that would eventually occur in November of 1997, and last for two weeks. In spite of these difficulties it seemed as though the actual conflict was quite distant as we met in Cal's small office. There was a feeling of security within the building, in part, I believe because the surroundings were so similar to the stereotypical images I had of a physical education office within a high school. I later would write:

Cal's office reminds me of some kind of dressing room with boxes of books piled one atop another, old personal effects, various changes of clothes (athletic/academic) and lots of sport memorabilia posted. If it were my office I would get organized. (October 24, 1997, p. 18)
In spite of our different styles of organisation Cal seemed ready for each class and often excited to offer novelty; like the time they made Jell-O moulded cells in class with gummy worms; I suspect that this led to my observation that Cal was a contented science teacher. He was the most experienced of our group. Like most teachers who have to be flexible in the nineties he had taught in several departments at the school. He sent 'confirming messages' as he spoke of enjoying (valuing) basic and general level classes more than the advanced level students.

I like teaching general kids better than advanced kids, it's a little more work, but you get more satisfaction from it. Not everyone thinks the way I do. (January 7th, 1998, p. 4)

From this and many other feeling statements I got the sense that he and I shared something. I noted in my journal:

I get the impression that Cal and I have walked similar paths, there seems to be some equality in our communications.
(October 9th, 1997, p. 3)

When Cal and I got together it was like being with a close friend since we shared many similar insights and background, as I will discuss later. Cal was very much a leader and was respected by all participants in our group. His leadership was discrete, yet his tone instilled optimism and his humour encouraged us to reflect and laugh from time-to-time. Cal used tone (non-verbal communication) and candour to emphasise his points. For instance, on November 27th, 1997 he suggested:

We have had some P.D. days; I took a bunch of courses at the beginning such as additional qualifications at the University of Toronto, in science and math T.R. Is it difficult to take A.Q. courses during the year?
The optimism, directness and honesty led the way for other participants to follow suit in each of our group meetings. Indeed, it was Hargreaves and Fullan (1998) who pointed out; "leaders who display 'unwarranted optimism' go after difficult problems with fervour" (p. 119). 'Going after' assessment praxes was a difficult task, yet Cal was an optimist. Cal noted early in his journal:

I want to laugh at the questions, but I don't want to spoil the project. It looks like a good thing for us to do - action here and there - even though we may be striking soon. That is a bold action. (October, 10, 1997, p. 2)

I found that I too grew to respect Cal's willingness to tackle the 'lost causes' (reference to some general level students). I did so because this was where I have spent most of my energies in education over the past 10 years, teaching special education (behavioural) students. Cal's assessment of education, schooling and science was well seasoned with diverse experiences in many subjects, and with many memories of students and events.

6.2 Assessment Influences: As a Student

During an early morning session, before school had begun, Cal arrived a several minutes late, at least by my watch, with hands full of coffee and muffins. He explained: "The line was a little slow this morning" (October 1st, 1997). He referred
to a local drive through and we grinned at one another as we shuffled into his dark
office from the empty and quite cool gymnasium. Cal flipped the lights on to reveal a
desk full of ‘stuff’ and no place for us to work. I glanced at my watch as he began to
clear off his desk. I was a little annoyed that he was late and not prepared but I kept
these feelings to myself, I think. By the time we began it was now just 15 minutes
before his first class and I knew this would be a short session. I was curious about
the origin of Cal’s assessment methods, beliefs and values so I probed into his past.

T.R. - Let’s just start off with anything you remember about being assessed.
Cal - Just tests, and more tests. No subjective marks really, or anything; you
mean just science? In science, just multiple choice tests.
T.R. Were they fair?
Cal - Yes, good tests, I found.
T.R. How did that affect your beliefs of assessment?
Cal - Well because everything is changing, our society is changing,
especially in the grade 9 program, so many different levels, you have
employability and good end product. We don’t evaluate things like that.
Even something like notebook evaluations; that was something I’ve
never been evaluated on, at all. Not one teacher looked at my notebook at all
in secondary school. (October 1st, 1997, p. 1)

Cal recounted his experience with assessment as being fair, but narrow. I proceeded
to ask him how a narrow assessment could be anything but unfair. He agreed. On
another day, when he was on time, I continued to probe. He further reflected on his
assessment experiences, first as a student and then as a teacher.

Cal - I know when I went to school it was 60 percent test and 40 percent
examination.
T.R. What would your percentages be today?
Cal - 20 percent tests, 10 assignments, 20 labs, 10 quizzes, 10
notes, 5 Olympics, 25 exam.
T.R. Who decided that?
Cal - We met as a group [department] and decided that. (October 8th, 1997, p. 2)

Assessment weighting (percentages) showed some change over the years. Yet, most assessments were paper and pencil (Appendix Q). As a teacher, Cal used a similar scheme. He later wrote in his journal:

School was always tough because they only seemed to care about what I remembered and not what I could do — But I try to assess so kids get a chance to show something — I need to try some more in class. It's good to talk about what we are doing and not doing. (October 8th, 1997, p. 1)

The interesting point in his journal was the suggestion that he needs to do more actual science activities rather than more theory. Still, Cal mentioned that when he was a student, the assessment was 60% written tests and 40% written exam. Cal as a teacher now employed 55% paper and pencil written assessments (25% examination + 20% tests + 10% quizzes) and 45% performance assessment (20% lab reports, 10% written notes + 10% assignments + 5% Olympics). In other words, more written than performance based assessments. The written content usually meant absorbing the information in the textbook. In Cal's classes there was limited opportunity for students to assess themselves or peers and really no attempt to assess attitude. I noted in my journal during a classroom visit:

Cal came into the room five minutes late and then spent the next 15 minutes handing out papers (lab), supplies (handouts), reviewed what was done last class, joked with a couple of students who were off-task and returned some homework that he marked. He never left the front of the room and mostly fielded questions as they read the text and completed a worksheet. The office called for two students who never returned and at the end of the class everyone left when the buzzer went as Cal shouted out reminders to students. He then scooped up some
papers and went to another class to get ready. This science class is typical with its hard plastic stools scattered around three long, wide (over a metre) black bench type worktables. Nothing was hung on the walls except safety posters. Both Cal and his class seemed so transient; they arrived and left no evidence that they had ever been there. The class seemed empty emotionally as if people were robots.

Note: Ask Cal if he assessed during this class — if so what? (Journal, November 12, 1997 p. 15)

The observations were attempting to detail the work of Cal on a typical day. The fact that not much happened seemed significant when you contrast it with suggestions made by Earl and Cousins (1995), the Ministry of Education and Training (1997d) and Stiggins (1994), who emphasize more higher order performance activities via student-centred assessment and less teacher-centred means of assessment. Clearly, the evidence (Appendix K) suggested that assessment had not changed much for Cal from his days as a student or a teacher. Cal wrote October 12th, 1997:

School is a place where we do what has always been done. It is protected from change because change costs money and we don't even have enough for the building or the labs. (p. 3)

Cal was frustrated with the state of funding and talked about switching schools to see if it might be better somewhere else. I suggested to him that there is a belief in teaching that it is better someplace else when in fact it may not be.

Preservice Training

As Cal and I reminisced, it caused us to remember the fun we had during our preservice. Each warm story brought about another. It was as if our reflections caused empathy. Cal later wrote:
When we start to talk about the old days I wonder if all teachers should get together to talk about this as it seems to loosen us up, it's good to look back to energize the present. (October 13th, p. 4)

It was evident from the onset that Cal had learned to teach by teaching, having learned little or nothing, he claimed, from his B.Ed. program. He spoke regretfully about the isolation of Faculty in the B.Ed. program, saying that they seemed very far from the front lines of teaching. Cal suggested that Faculty of Education professors were, for the most part, viewed by most preservice students as ineffective in their quest to facilitate assessment literacy (among other things). Again, current assessment literacy involves awareness, understanding and the application of assessment terms, (language), skills and strategies, which is agreed to and shared by colleagues (Hargreaves & Fullan, 1998). This level of literacy seemed missing for Cal as a preservice student and he was quite disappointed with this reality.

Hargreaves and Fullan (1998) would like us to believe otherwise of today's Faculty of Education, yet they do admit some past error, in that "Faculties of Education and their universities, in partnership with schools and districts, have a vital role to play here - something which they have not been good at in the past" (p. 104). Teachers need a theoretical foundation in order to develop and grow. A sound theoretical appreciation promotes a receptive attitude towards educational research and theorising. It may be that teachers learn a lot on the job but it is via reflection and critical sharing while in practice that most growth is realised. The danger of being dismissive of preservice is that it could lead to an a-theoretical approach which would put teachers in a static position; the opposite of good pedagogy. To me, it seemed
clear at the time that the Faculty of Education Cal attended needed to improve yet this is common to all programs where training occurs. As Cal continued, he spoke passionately about his best teaching experience in a Toronto secondary school, where he learned how to teach. It was an awakening! The following excerpt from a one-to-one interview on February 4th, 1998, illuminates several important points.

T.R. If the Faculty of Education was not a good experience then where did you get your assessment training?
Cal - By teaching and from teachers I had, because I thought I was assessed fairly, so I do what they did.
T.R. So you assess the way you were assessed?
Cal - No, I knew you were going to say that. I would say that there are some aspects of assessment that are the same. I learned even from Professional Activity days here and teachers, and teaching summer school at Humberside Collegiate. We were legends at that school -- I think that part of the problem with Teachers' College, the professors were out of the classroom so long they had lost perspective. I learned mostly from colleagues who discussed reaching general students. (p.1-2)

Cal has implicitly indicated that he learned how to assess by following the example of confident teachers he had worked with. In doing so he inadvertently maintained the status quo. Further, Cal cheerfully emphasised his apprenticeship on the job as the richest source of learning, not the Faculty of Education. He had dialogued with certain colleagues that, as an outcome, raised his level of assessment literacy. However, his Faculty of Education training was viewed by Cal as disconnected from the reality of the classroom due to professors who had not maintained good partnerships with schools and their Boards of Education. This has led researchers to suggest that "most teachers were not originally trained for teaching kids complex performances, . . . . And that training is important for implementing and designing
assessments (Cohen, 1995, p. 8). True enough! Cal received little formal assessment training. What training he did receive at the Faculty of Education, some 10 years ago, he has deemed wanting. Cal and I talked about the assessment research assertions and agreed we had time to recover but not enough time to move (action) assessment as far to the student-centred mode as we would have liked to in our practices.

6.3 Assessment Targets

From the beginning, Cal and I shared similar records of experience and an appreciation of teaching students who were not placed in the advanced stream of secondary studies. Another similarity between us was that we had both taught science and physical education at the secondary level. Both Cal and I shared a concern for what is targeted, measured and recorded in assessment efforts (form/function). We saw a need to look beyond the content (topics) of some course outline towards a more holistic assessment, which considers the social skills and capacities of students (attitudes). We both believed the goal and purpose of education is to help youth become a positive force in society. Cal recorded his thoughts:

School has always been there for all kids and I want to give everyone that same thrill I experienced. What I mean is the joy of effort and success—to be sure it will happen—but I need to give everyone the chance to do well. The question is really what assessment can do this? (October 10th, 1997, p. 2)

What Cal assessed needed to be examined via multiple discussions and a great deal
of reflection was invested to clarify and sort comments, to really understand what he was concerned with. Often, a question created many different reactions, feelings and stimulated more questions. We needed time to examine responses, sometimes a week or more. By March 4th, 1998, we had completed many recursive discussions (action) involving questions, suggestions, and then reflection. What we were missing at this early stage was more action within his practice. Consider this October 1st, 1997, excerpt.

T.R. What do you assess?
Cal - Well, first of all, I think it's a way for the student to learn.
T.R. So, is it difficult to discover the extent of the learning?
Cal - From the transition years, and in the past couple of years, the kid knows he doesn't have to pass. I mean he doesn't have to do any work. Not a lot of kids; I mean in my general course there are a lot of kids who need it, but in my general course I test every four days. I do so that they keep getting feedback. They need it more than the advanced kids. Seeing that they are progressing they're going to keep working. If it's too long between an evaluation, they won't work. So, if you don't get evaluated, in essence, I don't think a kid will work. If you're asked: "Are you going to mark this?" and you say "yes," the kid will do a better job than if you say, "I'm just going to look at it." (p. 3)

This excerpt came from our first group discussion which was held in Bob's guidance office. Many may agree entirely with Cal's view here and see merit in his response. However, at this point, I think we were all happy and excited to be involved and I wrote later that day.

Our first group discussion went well. Cal does a wonderful job (politically aware). It reminds me of some of the good parts of teaching. There is a bittersweet element to his insight in that he seems frustrated with the system especially when the strike is just weeks away. Cal is trying to keep it together just for us but at times he is edgy. I get the sense that there is some contempt of Pat, I don't know why — maybe I'll
Our first group meeting had a sense of freshness as I could tell by the playful excited tone in the room. I did however, pick up some detachment in Pat which I will discuss further in Pat’s chapter. Eventually we discussed the need for assessment in all three domains — psycho-motor, cognitive and affective — that addressed both the process and the products, and the form and function. Cal and I understood the psychomotor domain from our work as physical educators. However, the cognitive, especially higher order thinking skills, and the affective domains were much more elusive when it came to assessment, as was the issue of motivation that often seemed to punctuate our discussion. Assessment was a chance for students to put on paper what they knew about certain topics covered in class and the text. My journal entry from November 20, 1997, read:

Cal appears to spend a lot of his time designing a novel curricular experience for his students. However, he does so to inspire, and to motivate a general/basic stream of students that need a great deal of encouragement. These students can tolerate little amounts of failure in a system that is anchored in judging, criticism, assessment and labelling. Cal has taken on a role as coach, first, and a teacher second. (p. 23)

Cal used assessment to find out who does not know. He looked to see who has not yet mastered knowledge and who has failed to retain bits of information, rather than looking at the extent to which students synthesise new and existing knowledge. Cal did not assess to see what was known before the students began working (pre-test). Whether this is right or wrong is really not the point here; I was more interested in assessment illumination. At this juncture I was trying to establish and understand
Cal's assessment practice. I recognised that simply by asking questions I might initiate changes in his thinking that could eventually lead to changes in practice. I reflected on our relationship.

Cal has accepted a role that is comfortable yet he suggests in discussions how he will and should do more performance based student-centred assessment and make an attempt to include attitudes however since the term has already started he seems drained at times due to the uncertainty cause by our discussions. (Journal, October 9, 1997, p. 6)

On October 1st, 1997, Cal related one of his attempts to target group skills.

We did spaghetti towers and 30 percent was on group work - I just wanted to hear some of their answers - some wanted to hear they did a great job or they didn't build a tower, so I think it's good for them to get some feedback to them because what they think is good group work and what you think is good group work is different. So that's a form of evaluation right there. (p. 2)

Cal was very interested in concrete, hands-on assessment events (labs, projects, activities), especially with his basic/general students who were quite active in the classroom in non-constructive ways. The Ministry of Education and Training for Ontario (1997d) had recently published the recommendations of the expert panel studying science, which suggested, "practical, hands-on assessments should be included and these assessments should also have an STSE focus " (p.14).

Assessment targets could include capacities (social skills), group (interpersonal) skills, self, and peer-assessments and independent study units (ISU's), which allow for assessment in all domains. Cal used most of these methods, yet was limited by his daily complex responsibilities and a lack of time to prepare his courses. Student
ability was considered a limitation on his selection of assessment methods, as was their level of judgement during peer and self-assessments. Our group of participants had varied reasons for assessment.

T.R. - Again, Why assess?
Cal - Like I said before, I think it's a way for the student to learn.
Bob - Jan said it encourages learning and achievement and shows what they have learned. (October 1st, 1997, p. 4)

Cal’s reasons for assessment quickly led to rationales. He suggested that assessment (function) is a way to learn about judging and that students begin to use higher order thinking skills by examining assessment praxes just as teachers do. I was worried that Cal was just being political and saying what he thought I might want to hear. The test would come later as I visited his classes time-and-time-again to view his praxes.

6.4 Assessment Methods: The Present

Cal had definite ideas concerning the methods he should employ in order to assess and this can be seen prominently in his assessment tools (Appendix K). Obviously Cal’s ideas came from two sources: his High School teachers and his many years of experience. Cal wrote

This strike is about to end but the best part is that I can now catch up on this research. I looked for the curriculum guidelines and I don't know where they are. I think Pat has some of them. I see what Bob says about our need to try these things out in class more often since we may have to be good at it by September of 1998 when the new curriculum arrives. (November 1, 1997, p. 6)
Cal appreciated the multiple layers within the issue of competency and was aware of the need for continuous development on the job. Cal and I, like many others, learned on the job and we were aware of our complex role and need to rethink matters often. I noted in my journal:

It makes me wonder how I got through High School given the thin layer of assessment. I am beginning to understand why I was so disappointed given teachers’ shaky grasp of assessment. I remember teachers who avoided the questions I posed and often were hostile towards any notion of an assessment appeal. I think I have a theory concerning their motivation to avoid my questions now. They were anxious and uncertain of the many issues related to assessment. (November 12, 1997 p. 12)

Cal and I agreed that experience alone was not a good indicator of competency in the area of assessment. Our beliefs appeared to mesh with Hargreaves and Fullan (1998), who tell us there is a need to strive daily for competence.

Teachers who see teaching as something that is mastered in early career and that they then know how to do for the rest of their life, get poorer results than teachers who see teaching as being intrinsically difficult, in which improvement is always possible and necessary, especially in a culturally diverse and technologically complex society. (p. 49)

Cal saw each day as a wonderful learning opportunity, especially at the teaching level of the general/basic student. In an October 8th, 1997, one-to-one interview, Cal explains some of his beliefs:

In general class, I think if they have too much information to recall they do not perform well. I think small tests spread out over the year is better for them. They don't get as worried or upset about tests if they know they just have a bit to cover. I think 76-minute periods are too long. They can't concentrate for that amount of time, no matter how hard you try or how interesting the lesson is. (p. 1)
Cal then attempted more frequent assessments. He put a lot of emphasis on course
content (textbook topics), emphasising knowledge of definitions, facts and figures. I
regarded Cal's suggestion of too much information and the need to control the
amount of exposure to new information as a throwback to an old assessment
paradigm. For instance, in the past the efficiency of assessment and the acquisition
of knowledge (facts, theories, figures) were the main goals. Not the development of a
critical stance or attitude towards science. Cal cheerfully discussed his assessment
methods and often supported these with rationales, for example:

I test on a weekly basis and I think it's important for those general
students to know exactly how they are doing, cause that's important to
them. And if they don't get regular feedback they do less and less work
as the year goes on. (October, 8th, 1997, p. 1)

Cal believed that the function of his assessments was to inform, motivate and
maintain interest in his courses. Cal believed in the teach-test-teach-test teacher-
centred model of education and had developed his assessment praxes accordingly.

On a classroom visit in December 1st, 1997, I saw what he was talking about.

I am struck by the way the class seems to focus on Cal as they probed
for details concerning an upcoming test. A typical student question
aimed at information getting concerned length, topics, and types of
questions and total number of items. The questions were common and
frequent to the point that Cal was noticeably embarrassed as I was
there watching as students pressured him. Once in a while during the
class I noticed Cal defuse a situation with some humour. Students were
puzzled by my presence yet Cal told them I was just a friend. Cal had a
warm relationship with the students and could be quite strong verbally
when necessary. Cal suggested the test would cover certain topics and
that was all they needed to review. The students sat on stools for the
70 plus minutes and were busy recording the information Cal had put
on an overhead projector. Cal then handed back a lab he had marked and the rest of the class was spent discussing the right and wrong answers on each person's work. The buzzer rang and students left intuitively. (p. 8)

The classroom visit was unique for me, however students seemed to be going through the motions of another predictable class. From my perspective, the events proved unremarkable and provided me with enough evidence to suggest to Cal that he might wish considering changing some things. I also remember that about a month previous to this visit I had asked him how his assessment had changed since he started teaching some 10 years ago.

I test totally different. I think you learn how to ask better questions; you learn by the feedback, and feedback is if 90 percent of the kids don't get the question correct then you didn't ask the question properly and you didn't teach that section properly. That's how I've changed the curriculum, the way I teach certain subjects, because of how the kids do on an assessment.

T.R. So your assessment would include knowledge, social skills, or?

Cal - For science, I think the test should be on all those facets.

T.R. Domains?

Cal - I think it's hard to come up with all those things — It's easier to come up with knowledge tests than other tests in other domains.

(October 8th, 1997, p. 2)

Again, the need for efficiency and ease of implementation was prominent in our consideration of the assessment process. I visited his class again on December 10th, 1997, and recorded the following:

Cal has all the students assume predetermined seats in the science class. Each student sits perched atop a stool and waits for a sheet of paper that has the latest questions from a chapter on units of measure and matter (Appendix K). Questions are true and false, short answer, fill-ins and solving problems via formula. For 60 minutes the room is silent as Cal assesses notebooks (using the form included in Appendix K). Some students finish and collect their notebooks stopping briefly to
locate the grade. Students then depart in a subdued manner as Cal gathers his test papers and glumly moves onto his next class in the gym. He has 10 minutes between classes to go to the bathroom, check his mailbox, grab a snack and set-up for the next class. I follow him as he manages to tell me he forgot about this test he was to give today in science class. He looks tired today (p. 12)

In sum, my classroom visits did not reveal much more than I imagined they would. Cal had a content-based program (Griffin, 1998). At times it was hard for me to sit through these classes as I became bored and my mind wandered. For most of the students I would suggest the same. I wanted to see more complex performance-based assessment activities yet these were few, with one exception, the annual Science Olympics. Was Cal really aware of his praxes as compared to the images he created in our discussions? There seemed to be some dissonance.

6.5 Assessment Modes

Science Olympics

The Science Olympics are a one-day assessment event which allow a student or students to exhibit their understanding of some aspect of science. Instead of being in class all science students attend this event. It was on this day I recorded several notions in my journal:

The 'buzz' is in the air. Applied science, the students appear excited. I videotaped all of the events after getting verbal permission from the Principal, Cal, Pat, Jan and Bob. I didn't plan on this as a means of data collection it is really for my memory--so I can repeat this in my school. The students who followed me around explaining the event did a wonderful job and were proud of their efforts. I think this is one time when attitudes towards science can be energised and changed for the
better since they are actually 'doing' science, it's concrete and fun. (April 17th, 1998, p. 57)

This type of assessment and instruction was strongly encouraged in Ontario education in 1997 (Ministry of Education and Training, 1997d). The event included several authentic (section 2.3) tasks (Appendix L). It allows students to show what they know and what they can apply. It can demonstrate a level of creative understanding. Thus, the event complies with the guidelines of the 1997 expert panel on science, which made one very clear point about assessment: It should be, for the most part, hands-on, (Appendix Q) and have a Science, Technology, Society and Environment (STSE) focus (Ministry of Education and Training, 1997d, p. 14). Cal was an active participant and supporter of the annual Science Department Olympics. However, the limitations of time were, once again, a major constraint. Cal was a little edgy due to the fact that he had to leave to teach another physical education class in the middle of the science day. Limited time meant there was a barrier to more Department-wide events of this nature and this was emphasised time and time again in our discussions. Cal wrote on the last page of his journal:

It seems we just get something to where its fun and educational and the administration -- oh I know they have a job to do--but if I have to work in two or three departments at the same time then nobody gets enough of me. So what's the point -- it's over for me. (April 18th, 1998, p. 42)

Cal's frustration was one I knew all too well. It seems in education that administration is often unaware of staff activities and this creates unsettling feelings for staff.
Labs and Portfolios

Cal's assignments were closely related to the labs, as each student produced a report to be handed in. Out of this assessment praxis, Cal's goal was to improve learning for his students as well as improve his instruction. Yet his means of doing so was quite similar to his experience as a student. Cal believed that he had to have more variety in his assessment praxes than did his teachers when he was a student. For example, he took the time to look at notebooks (Appendix K) and issue a grade for effort, something his teachers never did when he was a student. Cal's paper and pencil written tests had the customary true/false, matching items, completion items, short answer, multiple-choice questions, as has been the tradition in Ontario secondary science education. In addition, he had used self-assessments, though only to a limited extent. Interestingly, his use of self-assessments increased during the lifetime of our project. He made me quite aware of the fact during a couple of interviews and seemed to want praise, which I had no problem supplying. Cal wrote:

I like to talk about my teaching. I do it best when someone is listening. Our group has made me care about doing a good job. I'd like to see some of these administrators doing what I do. I don't know if they could do it. They like to think they can assess but they have the training. They need to get together and do some action research, it's been good for me. I feel better now as the class is taking some of the work on and I have more time for other things. (February 4th, 1998, p. 22)

Cal had issues, as we can see, but his issues were ones I had become somewhat familiar with throughout my career. I agreed with Cal, to some extent. Teachers were being asked to do more in less time. For instance, Cal understood and valued the use
of a portfolio in science. However, Cal believed there were many versions of a portfolio. Some versions took too much time to develop and administer, let alone assess. Moreover, Cal claimed that he used a version of a portfolio.

T.R. Why do you not use a science portfolio in your assessment of students?
Cal - I guess, because I just mark notebooks. They have their own portfolio, in a sense; it's a binder. I don't use portfolios because there is no place to keep or put them, so I mark the notebooks after every unit. They have to have everything in there.
T.R. Do they know what or how you'll mark?
Cal - Yep. (December 3rd, 1997, p. 1)

Cal believed strongly that the notebook served as a portfolio because products and processes from different domains could be filed in the binder. Several limitations were immediately obvious, based on the Chapter 2 (2.3) information concerning this mode of assessment. For example, the portfolio (notebook) travelled with the student, so many items could be lost; criteria for the notebook/portfolio were not supplied or applied, so it was very much a subdued random exercise that was inspected for certain target tasks and not for longitudinal content or achievement. Cal did use some exemplars (examples of expectations) in his teaching, though not in the case of notebooks. Cal wrote:

The other day I was thinking about the time it takes to make up these examples [exemplars] and how it would be Ok if I had it. But I don't have time right now. I will not be able to do it--unless I get more prep or someone gives it to me or I could delay this until the summer. (Journal, April 17th, p. 30)
Self and Peer-Assessment

The self and peer-assessment tools had been used, in keeping with the science guidelines (Appendix Q). However, Cal lacked training inservice so he had certain reservations (see 2.3) that had to be addressed.

T.R. Do you use self and/or peer assessment?
Cal - I've been doing that since 1987.
T.R. Are there any new modes of assessment that you use?
Cal - I think I put more of an onus on them making up the assessment a little bit, but not all of it. I've tried this self-assessment thing for my grade 11's for presentations. They will not, unless they don't like the kid, give hardly any of the students a failing mark. They'll give them 50 or 51, but they will not give them a failing mark.
T.R. So, the student's minimal standard is 'passing', or 50 percent?
Cal - For some of them that's right. As long as they pass they are happy.
T.R. So, you could change the scale. Make it from 50 to a hundred, with 50 the zero. (March 5th, 1998, p. 4)

I found it interesting how Cal was unsettled by the reluctance of students to fail another student. Students, I surmised, would not and could not 'fail' their peers because of the taboo nature of failure. Students I have spoken to believe that no person fails; rather they just do not present the necessary quality at a certain point or points in time. It could be that students have a more useful view of low scores than do parents, or teachers, who may view these results as an indicator of something quite different. Cal invested a great deal of physical and mental energy to help students achieve and was willing to send a message of failure via any assessment. I pondered these points later in my journal:

There was a time when the teacher was the centre now it is the student
and some teachers don’t like the way the students assess. I didn’t like the way some of my teachers assessed either. So, is it better to have an unhappy teacher or unhappy students? I don’t know but the move is towards self-assessment, self-evaluation and self-regulation via portfolios. Cal says he uses the student’s binder but I need to know how he assesses the binder. It is not obvious to me. (March 18th, 1998, p. 52)

The only evidence of Cal’s ‘portfolio’ assessment that I came across was a sheet called “Notebook Evaluation Forms” (Appendix K), which appeared to have little to do with portfolios. Cal led me to believe he was working on another form but it never did materialise. My journal allowed me to revise and reflect on practice and theory. I had many ideas for assessment forms but the hard part was deciding how to apply these in the classroom (practice) in a manner that would be efficient. The fact that assessment was often confusing for us made it difficult to relinquish traditional assessment roles. In my situation, I was expected by participants to provide resources yet I wanted the group to develop them collaboratively. At times I felt aggressive towards participants who wanted the easy way out, but I was the one on-leave so I had to remind myself that we were all under pressure of some kind. My stance, at times, caused us to become static, in my view. Maybe I should have been more forthcoming and supplied tools for participants to use but then they would have been even less proactive.

**Performance Assessment**

Participants believed that performance assessment (see 2.3) in the form of examinations (Midwood et al. 1994) had a lot to offer. At the secondary level in
Ontario, exams are held usually at the mid-term and conclusion of a semester or year and are, therefore, viewed as both functional formative and summative assessments. Cal and I discussed the properties of exams on January 7th, 1998, during a one-to-one discussion.

T.R. How many exams will you be preparing?
Cal - Four.
T.R. Of those four, are any of these necessary?
Cal - Actually, it will give me more information. It's more for the general kids because they'll be, well, instead of learning a little in each unit it's going to be a test where they are tested on the whole term. It's on everything, so I'll see the different strategies they'll have to use.
T.R. Is it fair that out of this whole semester it is out of 30 percent? Is it fair that they only have one chance? Shouldn't they have a chance to rewrite?
Cal - I don't believe in rewrites.
T.R. You may not see their best performance.
Cal - Well, I mean it's fair. I'm going to have them prepared enough, so that it's fair. (p.1)

Many debates have followed the questioning of the value of the final examination for basic and general level students. It seemed to be just another paper and pencil test, although longer. It was mostly knowledge-based, required no demonstration of lab skills, and it was arguably not authentic (section 2.3). However, it did require thinking, organising and expression of their thoughts, which is challenging. Cal wrote pensively.

The exam, during our mid-term, would be best if you worked towards a level, say gold or silver. And then, in the final, the finish line was shown, and those who made it, got gold. And those who didn't, got other medals — It isn't a 100 metre dash; instead it is a whole term marathon. But I'm only a small piece of the puzzle who follows orders. A striker, picketed [sic] and a teacher. (Journal, November, 15th, p. 9)
While participants often imagined assessment in other forms it wasn’t until we were in group discussions that I was struck by the paradigm that Cal held. It was around the time of the strike. Still, the examination is very efficient in some sense, yet its usefulness is problematic (see section 2.3). Cal took ownership for the administration of this. He defended the high stakes of 30 percent for three hours of work per term. It represented less than 1/100 of the total time spent in his class that semester. I pursued this discrepancy with Cal.

T.R. You have tested throughout the term: Is this test at the end, which is summative, really going to contribute to your knowledge of their abilities or cognitive strengths, understanding, and skills?
Cal - I think I'm looking at how they react under examination pressure.
T.R. So the target is the effect of writing under stress?
Cal - I would definitely act if a student came to me and said they couldn't write today because they are under too much stress.
T.R. What if someone doesn't tell you?
Cal - I guess they will learn that they have to speak up.
T.R. So it's unfair then for the person who doesn't perform well on exams? They can lose a great deal, up to 30 percent that day.
Cal - They have to learn to speak-up -- I don't even have a policy (January 7th, 1998, p.1)

Cal's defence of written examinations as a form of assessment was curious. He suggested that his target was their performance under pressure (function) and not entirely their recall of factual knowledge. Even the latest suggestions from the Ontario Secondary School Teachers Federation point towards teachers' need to "...match assessment approaches with outcomes/purposes -- this will mean more use of performance assessment and less use of paper and pencil 'tests' " (Midwood et al. 1994, p. 401). I had several lengthy discussions with Cal about the trend and support for such changes in assessment praxes. One of the most revealing
I think that if you are going to be out doing a self evaluation and have it as part of the evaluation you have to start out small. It's a learning process, like I do self-evaluation for leadership and preparation, and I've got kids that help out a lot, and they give themselves 1 out of 5. I've got kids who do the opposite, and they give themselves 5 out of 5.

T.R. What you are saying is that they need a lot of help in developing their skills in fair self-assessment.

Cal - There are a lot of kids who just want to pass, so they give themselves 5 out of 10 - so it's probably going to take quite a bit of time to get them to do it fairly.

T.R. Assessment is part of the curriculum and it is a higher order thinking skill that is going to take some time to master.

Cal - I see why you are saying that because we have to create a lesson and then, on top, you're trying to create an evaluation, anyway it's just that extra. (p. 2)

I was probing on each occasion to fully appreciate Cal's understandings.

T.R. What about your consistency? The first of the term versus the end of term assessments?

Cal - No problem. For example, I make them do cover pages. The first one gets no mark and the second gets marked.

T.R. But does that reduce errors on assessment? What do you do?

Cal - Open-door policy. I make lots of errors, for instance adding it up wrong.

T.R. So, what kind of feedback do they get?

Cal - All the time, written comments, numbers feedback and report cards

T.R. Do you think your type of feedback is a good thing?

Cal - They're accountable; it motivates feedback questions and guides. (December 3rd, 1997, p. 2)

Validity is a serious consideration and a key feature of assessment. Who assessed, and their competence in this area, had a huge role in the overall quality of the assessment and hence had major impact on student learning. Our research experience caused participants to become aware of many issues and features within
assessment both personal and professional. Cal realised, maybe for the first time, how his assessment efforts caused some students to be successful and others less so. After all, assessment is an integral part of good instruction. Cal suggested that he needed to assess using more varied and student-centred assessments such as a self-assessment checklist. He wanted to put more emphasis on exemplars and develop more affective and psychomotor assessment tasks. Cal admitted that he needed more inservice assessment training to learn more and see what others are doing. These points were at times problematic and puzzling for both of us, given Cal's current schedule and limited time. I believe Cal began to make assessment a priority. He was now thinking about assessment issues before content coverage. The movement towards such assessment awareness was moderate, noticeable in his discussions but less so in his praxes. Much of the time Cal voiced his frustration via humour and opinion.

6.6 Awareness and Time

One of the research questions asks, 'what other learning and professional gains were realised during this study?' In Cal's case he learned or realised the extent of his isolation and the large role time played in his assessment praxes. Cal apologised for the length of his journal and he felt sorry for the extent of his donation. At first, I was disappointed to hear of its length but after reassessing my response I moved onto a feeling of acceptance given the mixed up year we had in the province of Ontario let alone at our school. Still, in response to comments concerning time limitations, we discussed time and assessment many times. This passage has been
highlighted from a one-to-one interview.

T.R. With time such a dominant feature does it eliminate the possibilities for peer and self-assessment?
Cal - They mark too easy — they won't go below 5 — I thought some of the of the assignments were terrible. They (the students) like "oh, its OK, they got 5," and I give them a 3 out of 10 to send a message.
T.R. Did they have specific criteria to look for?
Cal - Yep, they don't do it enough. I think they would improve if they did it more. They need more time to understand peer and self-assessment.
T.R. So you may increase self and peer-assessments in the future?
Cal - It's really scary (Bill 160); I just can't believe it's going to happen. We will have less time to prepare when we really need more.
(November 27th, 1997, p. 2-3)

In spite of the concerns expressed about self and peer-assessment, Cal did develop and use this assessment method (Appendix K) more often as the study unfolded.

There appeared to be a perceived need for a great deal of meeting time in order to validate assessments and, again, the reality of insufficient time meant validation would rarely occur. Further, Cal needed time to meet with colleagues in order to develop professional expertise in the area of assessment, but there was little chance of this happening given the passing of Bill 160, which severely reduces the opportunity for teachers to meet during a school day. Wood (1993) adds, "in many of today's schools it is almost as if someone designed the school day with the express objective of keeping teachers apart . . . most teachers seldom have opportunities to talk with their colleagues during the day" (p. 242). We agreed that without provisions for collaboration built into secondary teachers' timetables, assessment was stifled.

Time was a constant theme throughout our group discussions of assessment issues.
Some participants wanted more time in the day, in order to complete lesson
preparation and design a more thorough assessment; some wanted longer periods for classroom study. Cal wanted shorter periods for intermediate students. Cal believed there just was not enough time in the day to create assessments that targeted higher order thinking skills. So, his tests were pencil and paper events, which demanded only lower order thinking skills (Appendix K) in order to match, circle, define, name and list various bits of information. As well, there was certainly no time to get tests validated by other science teachers in the department, as each teacher was busy coaching sports teams after school or fulfilling other commitments. Most often, Cal would locate an assessment tool in a published text and adapt it, or quickly draft his own version using the text as a resource. Yet, as the years passed, he found time to invest in assessment tools in order to refashion his praxes during his summers. One such assessment tool effort essentially targets social skills (Appendix K, item 2) and requires students to complete self-assessments.

Another research question asks what was their level of awareness of current Ontario government pronouncements and in what ways did they implement this knowledge? On one occasion I thought Cal's lack of awareness of important assessment documents may have been a consequence of a lack of time, or isolation, or the search for individualism (Rudduck, 1991). However, Cal suggested the Board's administration was the problem, in that they had too many at the top and not enough people in the schools or classrooms. On February 4th, 1998, we touched on this possibility for a lack of assessment awareness. In our one-to-one interview, Cal suggested:
After 10 years, I can assess myself. You are constantly teaching different subjects and you don't have a chance to master the content and questioning. Questioning is an area that I know I need to improve in. T.R. And we need to improve assessment. This Board has a number of policy directives on assessment, yet do they have the people power to oversee such a policy? Cal - No, our Board is too top heavy in administration.
T.R. You need to have a P.D. person on staff. (p. 2)

Cal felt he had enough assessment wisdom after 10 years of teaching, yet was unaware of several assessment documents, which could assist him. Cal suggested that he attempted to illustrate student achievement by testing often, so they could have feedback every few days. He also hinted that assessment functioned as an incentive for students and a way of controlling behaviour in order to ensure the student’s focus was on the course. Cal used his frequent testing pattern as a way of diagnosing student progress. He used assessment both formatively and summatively. Cal regularly developed his own tests and quizzes, and there was no student input, even for labs. Student input was not used to develop the peer or self-assessment tools either. Yet, Cal maintained that assessment was a way in which students could learn. He meant that the students would learn what they did or didn't know. As previously indicated, Cal created all assessment tools, though on rare occasions he would borrow a tool or use a tool that was used by all in the department and had been designed co-operatively.

I asked Cal directly about his assessment target priorities and he often suggested there was not enough time to cover the basics in the curriculum. I thought Cal's concern with covering the curriculum meant he prioritised coverage and not depth.
How Cal assessed and in what form was dependent upon this feeling he had that there was insufficient time to cover all the material in the curriculum. He felt that these severe time constraints also dictated the assessment methods. Much of our study involved the issue of efficiency. Time to assess and instruct was always limited, hence time was viewed as a source of stress. He required quick answers and had little time to carefully analyse his practices. Our group, however, provided an opportunity to critically reflect on his assessment praxes. Usually a meeting would be limited, missed or interrupted by team picture day, team practices, tournaments, extra student instruction, and so on. Other forms of assessment, such as conferences, interviews, response journals (logs), oral tests, and essays, were not used because of time limitations.

It was agreed that the reason for assessment praxes being in their current state (low level, unsatisfactory, antiquated) was due to a lack of time. This coupled with the multiple demands of teaching resulted in an insufficient amount of time to do the job of designing innovative and comprehensive assessment tools. Hargreaves and Fullan (1998) illuminate the issue of preparation time for teachers thus:

The current situation in teaching is somewhat analogous to a lawyer who spends all of his or her time in the courtroom, and little time 'preparing the case.' Teachers have little daily time outside 'the courtroom' and what they have is often not closely related to preparing their case. It is time dedicated to meetings; workshops and courses that are often disconnected from the refinements needed to improve their own teaching on an ongoing basis. The teaching profession is badly in need of transformation so that there is a closer functional relationship between ongoing preparation of the case and their own professional learning. (p. 49)
Cal often mentioned the issue of time, as did each participant in this study. With the proposed reduction in preparation time, due to Bill 160 recently passed by the progressive Conservative Party of Ontario, the issue will become even more prominent. Time dictated the assessment schemes and ruled out the utilisation of certain tools, such as the portfolio.

T.R. So, if there were a portfolio would it help?
Cal - It would help, but it all comes down to time. There's not enough that's all. Even grade school teachers don't have enough time.
(December 3, 1997, p. 2)

Above all, Cal's immediate need seemed to be efficiency of assessment and instruction, given the impending time constraints, as indicated by this group discussion.

Cal - It would be a lot easier if we evaluated just in that way every four weeks. Hand out the multiple-choice test and put the results in the machine (computer) and no marking. But, it's not fair to the kids. We have to evaluate differently, to try to get all of the kids to pass.
T.R. So do you assess equally in each of the domains, affective, cognitive, or do you just focus on social skills?
Cal - I think most of it is on how they think; there are marks for social.
Jan - It's mostly the cognitive domain.
Cal - Like when they work in labs, 30 percent, and their group work is assessed also. (October 1st, 1997 p. 1)

In summary, I concluded that there were two possible explanations for the lack of sophistication in Cal's current assessment praxes: lack of time and teacher isolation (Fullan, 1991; Hargreaves & Fullan, 1998; Kosnik, 1994). Cal realised his assessment praxes were predominately shaped by the variable of time, which favoured the propagation of a content-based program and not an outcomes-based
program. Still, some assessment practices, such as peer and self-assessment, could save time and were considered quite appropriate, especially in the classroom of 1997-1998. Following our discussions, plans were put in place to use these assessment modes more often. The action or implementation phases were more difficult to realise, given the time constraints and pressures felt in the 1997-1998 school year. Some attempts were made but these were only preliminary and more effort was planned for the next year.

6.7 Change

Another research question asked to what extent did initial understandings and actual practices change due to the illumination of assessment praxes? In response to this question we need to be reminded that the act of reflection can be viewed as theorising (Schon, 1983), and the following demonstrates how reflection expresses itself in the life and work of Cal (Carr, 1995). We begin to see how Cal is guided by reflections (theory) and some of his ideas are made public via this text. The details provide some evidence of a change (or changes) undertaken by Cal in response to the attention we paid to assessment. Our discussions provided impetus for reflection on assessment praxes and this facilitated change. For instance, this excerpt of December 3rd, 1997:

T.R. Has this action research process -- discussion changed the way you assess?
Cal - It has made me think about what I do -- portfolios -- having others mark.
T.R. Do you have to mark everything?
Cal - No, if we do 5 labs, I pick 3 of them. (p. 2)
Having an opportunity to reflect on his praxes brought about sudden moments of 'awakening' that refreshed him (T.R. Journal Entry -December, 1997, p. 45). Indeed, "the very asking of . . . questions can start the emancipatory process insofar as some degree of self-reflection can be provoked in those who answer the questions" (McCutcheon & Jung, 1990, p. 150). I continued to introduce questions and theory that complemented our efforts to realise better assessment praxes. Questioning actually facilitated and supported the on-going discussion and moved us forward, for instance I asked,

Some researchers say good teaching is good assessment. So, part of our job is to teach them how to assess themselves. Would you agree?
Cal - But I think by giving them that checklist that's what you're doing, because you're showing them how to assess.
T.R. But that's imposed, there's no ownership.
Cal - I get your point, OK, but I still think if they have to do a self-evaluation and they know what's expected right then. They have to take ownership to make sure all those things are there.
T.R. How do you motivate them—if they aren't allowed to have input?
Cal - I guess by knowing it's a percentage of their mark.
This is a tool to succeed in this class and other classes.
(December 3rd, 1997, p. 1)

My intention was to get Cal to see the benefits of having students complete activities that required higher order thinking skills, such as evaluation. Cal noted in his journal.

We are all the same — it's like we work in our classrooms but we end up doing what needs to be done, like making sure the students study, try hard and my job stays the same. Our group meetings are a way for us to move on to more self and peer-assessment, maybe it will decrease my workload and I can say OK — students you need to develop your next test — they could probably do it, at least 70% are mature enough. It would be quite a change but I think we need to move in this area.
A transition was underway. An old paradigm gives way to a new one. Cal was able to see that maturity, defined as the ability to make good decisions, which was also the basis of good citizenship, was not related to age. Moreover, Cal and I agreed earlier that good citizenship was our overall purpose in education. My ambition in this discussion was to clarify our beliefs concerning empowerment in the assessment area, which could change Cal's assessment praxes. I discussed the matter with him.

T.R. What do you want to achieve in the science curriculum? Cal - To think at an elevated level and to apply what you learn, infuse values. T.R. Are these purposes/goals for science shared with students? Cal - I think it's difficult because of lot of them haven't taken science before—if you give them a question they want to look it up in the textbook and just have it be there. T.R. If we define science as the study of our world and its mysteries, I can almost guarantee that at some point in their elementary years they have looked at one of the properties of our world, for instance, magnetism. My question is why couldn't they look at the same topic in more detail or depth in secondary school? Do you know what they did in science at elementary school or talk to feeder schoolteachers? Cal - No. T.R. So if there was a portfolio... Cal - It would help but it all comes down to time. There's not enough that's all; grade school teachers don't have enough time.

Cal critically reflected upon many assessment modes and contemplated possible changes. Cal wrote in his journal December 30th, 1997, that:

The holidays have given me a chance to look back on the first term and I have a plan to get the kids more involved -- I can share this in our first meeting -- but I still need approval from the bosses. It is a risk to move away from what is comfortable to something untried. (p. 12)
This suggestion that change is very difficult, not because of the theory that needs to be put into practice but due to a reality in the classes illustrates the stresses under which many teachers work. Many of the grade nine and ten classes are over 30 students. During a classroom visit on October 8th, 1997, I noted:

The class is too big (32) for this smaller classroom. It seems that the 76-minute class length is too long on this day, even for me and I'm just observing. The attention span of the students seems short today, so I can see why Cal likes efficient means in this class. Cal seems distracted by the activity level of the students. He keeps looking at me to check my expression. His attempts to get them focused on the textbook are not entirely successful. He warns them of a test next day and they now get a little quieter. Four or five hands go up with what are the usual fact-finding questions. How long is the test, what is it on, how much time do we have and how many marks is it. Cal grows a little iritated and states 'just wait and see'. Since I spoke to him before class I know he's tired and this is not a good mix with a challenging class. He hands back labs and talks about what was wrong. All students divert their attention to the handouts. More questions about Cal's grades. It seems like a typical content-based program at this point. (p. 5)

Cal was using the threat of assessment (tests), as a means to control inappropriate behaviour, which seems a common strategy. I have even done this myself. Perhaps it is too much to expect in the face of administrative errors and political problems that Cal change his praxes so early in our study. There are so many factors impacting on our study that have to be considered. For example, is it really necessary to have over thirty in a class? Of course, money dictates pupil-teacher ratios and a reduced class size might necessitate the hiring of new teachers, expansion of the school and increased material costs (textbooks, lockers). On January 7th Cal and I discussed assessment possibilities and the direction in which we were heading. I asked about
one assessment mode in particular.

Are portfolios possible?
Cal - I did it for math last year um; I probably will do it for math next semester. I like teaching general kids better than advance kids do. It's a little more work but you get more satisfaction from it. Not everyone thinks the way I do, that's a good idea with regards to keeping it, I'll see if the grade 11 teacher is interested in looking at it or keeping it.
T.R. Due to the cutback in time and Bill 160, are you going to move towards graduation by exhibition, presentation with peer assessment and self assessment?
Cal - Definitely, hum. (p. 3)

Cal was very much a flexible educator who had attempted to build a student-centred assessment program yet he realised he had more work to do and our work together was helpful. Cal needed help to change and he saw little help forthcoming for the classroom teacher. Our research efforts are all the assistance and support Cal can call on at present. We continued to exchange thoughts on assessment and speculate on its future forms and functions in Cal's classroom.

T.R. Do you get a chance to go into other classes?
Cal - No and I have more on-calls and not enough time for prep so I'll have to do it after school and some in the summer.
T.R. Do you really know what is going on in other science classrooms?
Cal - I think I would know due to staff meetings and when we teach same grades we meet to discuss things after and before school. So it was on our time. It would be nice if we had the same prep. It would be some benefit to see how others assess -- I know each of their teaching styles I could tell you.
T.R. OK, go for it.
Cal - Bob uses a lot of concrete examples with hands-on and assess using paper and pencil and performance, Jan the same, with lots of labs, notes on board. Pat has lots of overheads and I don't really know because she's only been here a few months.
T.R. How do you have to improve in assessment?
Cal - Work on my questioning verbally and on tests and I'm fair and
use a lot of hands-on activities. We've worked together in the past but people are self-conscious and it gets in the way as well as time limitations. I'd be concerned with the critical feedback.

T.R. What about opportunity to learn?

Cal - Well I learn something everyday and if you don't you are not risking enough.

T.R. I was referring to the students.

Cal - I think that getting yourself too worried about the facts in the Ministry guidelines causes anxiety. I think teaching the process of science and thinking skills of science is important — sure the definitions are important but how to apply science is important too. (February 4th, 1998, p. 3)

Cal was suggesting he was more interested in the outcome-based program where he facilitates and supports students to realise some achievement. I ventured into his class shortly after this exchange and was quite taken by what I thought were the changes, compared to earlier visits in the fall.

As I entered the room Cal was busy arranging items on desktops and several students were helping him. He explained that these senior students were on a spare and assisting him to assess lab skills in this grade 10 class. Each grade 10 student would have to identify, draw and suggest uses for each item. It seemed practical and useful and I later learned that the task was developed, in part, by the students from that class, after a discussion of lab safety. It was not written down yet but Cal was trying something different. He wanted to see how many could pass. Results would be immediate as his assessors could handle the data and report to Cal. Cal seemed happy and I was happy for him. As the students arrived they sat at each of the 16 stations and when Cal was finished explaining they spent several minutes at each station until it was complete some 60 minutes later. What was most interesting was the idea that students would work in pairs to encourage co-operative learning and enhance the chance that each pair would pass. Cal's target was social skills (co-operation), knowledge (identification), skills (drawing) and required a written explanation of the items usage (practical). The period ran smoothly and only one person arrived late who then had to work alone. I saw this period as a transition, a leap away from the classroom visits in October and November. (p. 43)
It has been said that "action research encourages the researching teacher to develop strategies for action to improve the situation . . . " (Altrichter, et al. 1993, p. 53). Cal was making attempts to improve assessment. Some of these I saw and some I just heard about since I could not be with him all of the time. Many more points of transformation are detailed in the following sections. In sum, Cal became more dedicated to alternative and varied assessment modes that required more input from students. While he was already using some peer and self-assessment (Appendix K) he indicated he would do more in future. He also noted the usefulness of portfolios and suggested that he would pursue this in the future, possibly in 1999-2000.

**6.8 Autocracy**

This section addresses one aspect of Cal's assessment practice in response to the research question that asks, what were participant's initial understandings of assessment and actual practices at the onset of this research? As well, the following supplies insights that shed light on the research question that asks, what other learning and professional gains were realised during this study?

One realisation at the onset worthy of comment was the extent to which the teacher (Cal) controlled assessment, allowing students little input into assessment, other than some infrequent token self, peer-assessment and the annual science Olympics. This assessment autocracy in the classroom was defended as a necessary practice because time limitations severely curtailed co-operative assessment opportunities. Stiggins (1994) has suggested that: "If you want to maximize learning, teach students
to assess themselves " (p. 42). Also, having others assess, whether they are parents, students or other teachers, can increase the validity of the assessment, since you are not the sole judge. I explored this possibility in our discussion.

T.R. Do you ever have an opportunity to have another person, colleague or adult come into your classroom to assess a performance/exhibition?
Cal - We do that on certain projects such as the Science Olympics.
T.R. Did you develop your criteria together and do some practice rating/marking to see if your assessments were consistent?
Cal - Everyone has his or her own opinions, so I don't think practice would help or ensure that it's going to be fair I think that 95 percent of the marks would be the same.
T.R. There was a study in the 30's where they sent out an English paper for teachers to mark; some people failed the paper, some gave it A+. There was a great range in marks.
Cal - Did they give them criteria to mark it? We had specific criteria. (December 3rd, 1997, p. 2)

Assessment is a means of collecting information about students and curriculum provision. The design of assessment instruments is crucial to their effectiveness in gathering data. Since many teachers are not very 'assessment literate' (Earl & Cousins, 1995; Stiggins, 1994), the quality of assessment data is markedly affected by whomever designs the instruments. The participants recognised this, and were eager to learn how to do a better job. Hargreaves and Fullan (1998) suggest teachers " . . . need to become highly skilled in assessment because it is these areas that make teachers feel very insecure " (p. 98). As we progressed through the study, I came to the conclusion that participants were quite eager to learn and welcomed the opportunity to deal with assessment in a frank and candid manner. For instance, our discussion of assessment potential and ownership led to this exchange.
T.R. Who developed the criteria?
Cal - I don't think they know how in grade 9. They don't realise it's a tool to study with.
T.R. In my grade 4/5 they were able to tell me what was good writing, so why couldn't they do that in grade 9?
Cal - I guess they would come up with the same things.
T.R. How is that different from your list?
Cal - It wouldn't be that different!
T.R. So they could do it?
Cal - Yes they could do it -- that's the weakest point.
(December 3rd, 1997, p. 1)

Time after time we arrived at new realisations during our discussions. For Cal, it was a chance to discuss his perspectives concerning student ability and assessment in general. By exploring Cal's thoughts on numerous assessment issues, I was getting a good indication of his assessment beliefs, values, needs and philosophy. Cal was reluctant to entertain thoughts that would create doubt. He believed for the most part, that his means of assessing were the right ones, given the context, as he knew it. Cal's reluctance to shift responsibility for assessment onto the student stemmed from his belief that they were not capable of completing the task sincerely or properly. However, I believed, as did OSSTF in their text: Assess for Success, that "... a small percentage of evaluation responsibility totally within the student's control is preferable to a larger percentage ostensibly 'negotiated' between the teacher and the student " (p. 122). Cal's lack of confidence in the ability of students to carry out assessment appeared many times throughout our discussions, and he gave many reasons for his belief. However, I still believed it was an issue of efficiency, since teaching students to evaluate is within the highest order of cognition and would require a great deal of time, effort, and practice to get the process working effectively.
I believed that the larger the role played by the student, the more engaged the student would be, and hence, the assessment would be more valid in the student's eyes.

T.R. If you were taking some of the autonomy away -- wouldn't that depress some students? Cal - I don't think so. A few people maybe. However, I think, overall they need some structure.

T.R. If the office gave you an assessment tool and told you "this is the way to do it; would that take away your autonomy? How would you feel? Cal - I think when they do that they expect you to be a professional. T.R. Let's say an outside body told you what to do, how to do it, and you didn't agree. Would you do it, given the loss of autonomy? Cal - I probably wouldn't do it. T.R. Do you have students who aren't doing it because they feel this way? Cal - No, I don't think so, not at all.

(December 3rd, 1997, p. 1)

My questions were intended to probe deeper and not oppose the points made. I wanted to encourage further critical reflection in an attempt to clarify thoughts and not debate issues or antagonise. Clearly, Cal did not have confidence in secondary students' ability to assess and by conducting his assessment by himself he believed there would be no loss of motivation for the students.

However, I did not share this belief.

In sum, I concluded that due to Cal's level of autocracy (isolation) on the job, which was both imposed (scheduling and facilities) and selected (choosing to work alone to increase efficiency), all assessment could easily be challenged. For instance, the issues of validity (content, constructs) within assessment in the secondary school is
serious if only one person with limited, if any, assessment training is saddled with all assessment duties. Despite these time and expertise limitations, there is little impetus to justify assessment praxes in schools, unless a complaint or question is raised directly with the teacher or administration. As a consequence, assessment exists as a largely unexamined element within the curriculum.

6.9 Fairness

Another theme to emerge in the illumination of Cal's assessment praxes was the issue of fairness of assessment. By addressing this issue we shed further light on the research question: What were participants' initial understandings of assessment and actual practices at the onset of this research?

Although Cal was very aware of the need for fairness of each assessment event, and gave this issue a great deal of consideration, neither the department nor Cal were aware of Principles for Fair Student Assessment Practices for Education in Canada (Joint Advisory Committee, 1993). Cal struggled with 'being fair', as this excerpt from October 8th, 1997, shows:

I find that hard sometimes, you're always learning — I sometimes go over the paper 3 or 4 times because I don't want to be unfair to the students. When you evaluate something it's only human nature, I mean, I just try to sit down and do it all at once so I'm in the same mood. It's just human nature, you can't be perfect and your mood affects the student's mark. I wouldn't say a lot — any more than 2 percent. I would feel guilty if I gave one student a mark for evaluating what they did and another student had the same information and I had two different marks for them, you know what I mean? (p. 3)

Cal made a similar point again on November 27th.
You should always be concerned and ask, am I fair to this person? I think that's the difference today and when I started, especially when you have a grade 9 class and you have to consider each student individually. (p. 1)

Most of Cal's assessment validation addressed the face-validity and never involved another colleague unless it was a final exam, in which case the department Head (Bob) would look over the examination. As well, Cal viewed self and peer-assessment as problematic due to issues of fairness, honesty and lack of ability on the part of the students. I saw it as more a result of not enough exposure (practice) to these assessment tools and the theory they are based on. I brought in several resources for Cal to look at and our related discussions encouraged him to move forward, especially when I recalled my success along a similar path of student-centred classroom assessment development (Ryan, 1998a). Cal's response was to increase alternative assessment practices and put in place plans for the future.

One of our group's long-term goals was to refine our ability to judge the level of performance in our classroom, keeping in mind the benchmark (content/standards). As our study matured, our group wanted to find better ways to assess but we ran short of time, and participants suggested they would attempt to meet as a department to continue to reach for this goal following this study. It was theorised that the use of multiple assessors would improve outcomes. Then, as outcomes were achieved our ability to rate performances in concert with our colleagues would similarly improve. This, in turn, would enhance our skills and improve our self-assurance concerning assessment and evaluation. In doing so, the quality of our curriculum framework, its
benchmarks and the assessed performances bring more of a benefit to students and staff. As one improvement led to another we discussed the eventual need for a critical friend. A critical friend is common in action research to help realise goals (McNiff et al. 1996), yet it requires more time to meet and reflect critically. However, given full timetables and personal schedules that often conflict, plus the dominance of other systemic demands, there appears to be little room for critical friends. In sum, we believed our forum provided an unusual and rare professional development opportunity for secondary educators.

6.10 Tensions

The following addresses most of the strains we encountered and acknowledges much of the work necessary to achieve certain outcomes. We were constrained by a strike, stretched (in a good way) by action research and laboured to improve assessment as we reflected and acted recursively. Similarly, we stretched to see other points of view and we were strained, by the attention our personal and professional praxes were given.

Strike

Cal's 1997-1998 school year was memorable for many reasons. One of the most stressful reasons was the two-week strike in November 1997. On one side was the Provincial Government of Ontario and on the other were educators. The tension in 1997-1998 was created primarily by the proposition of legislation (Bill 160) as the government moved to alter existing structure, in this case Ontario education. Every
teacher in our study, felt the tension, reacted to it and picketed for two weeks. Cal walked the line with all participants in this study. We talked about our needs during these turbulent times, yet it was Hargreaves and Fullan (1998) who may have said it best:

Education happens when hope exceeds expectation. Teaching is what makes the difference. Teachers everywhere work miracles without many of the resources or support they really need. Without hope, teaching is nothing... Too many of our teachers are starting to lose hope. We are in serious danger of undermining a fundamental truth of educational effectiveness -- that the learning and emotional lives of students are profoundly dependent on the learning and emotional lives of teachers. (p. 87)

Cal was hopeful but surprised by the turn of events during November. Our study was a beacon for us. Cal wrote:

It is hard for me to imagine why anyone would want to teach today. You work before and after school on preparation, you teach, counsel and guide students during the day and then you coach after school and on weekends. Any holidays are spent marking and the summer is a time to take additional qualifications and still we are attacked by our employers. The government -- it upsets me -- I now close the door and look for ways to be more time wise [sic]. (January 4th, 1998, p. 13)

Upon reading this entry I was reminded of a retiring teacher at my school who told us that he had counselled his son away from teaching. I suspect that both Cal and I might opt out of teaching. However, we have gone this far and invested so much to this point that we need to see over the next hill. It can, after all, only get better as we remain hopeful. Perhaps a change of schools could revitalise us, as Cal has mentioned this once or twice during our study. Cal's spirit was intact yet he was
distracted, as all participants were during 1997-1998. I noted this, during the strike, in my journal:

I can't believe we are on strike. Teachers are angry and frustrated but I don't get that sense within our group. It seems as though they are detached somehow. Some teachers are actually happy to get a break, many suggest it can't last long its all political posturing. Cal has always got a joke to tell us he's the playful type. Pat is a little more serious and is quite annoyed with the loss of her pay cheque. (November, 15th, 1997, p. 18)

The strike and the legislation (Bill 160) were sources of tension. Hargreaves and Fullan, (1991) add:

Any educational reform strategy that improves relationships has a chance of succeeding; any strategy that does not is doomed to fail. This is why formal policies and procedures themselves will never provide the answer. Decades of research on and experience in human relations and organisational development in the business world have shown that good relationships aren't just emotionally more fulfilling. They also lead to higher productivity, improved problem-solving and better learning. (p. 90)

This position has grown out of an earlier thrust to popularise the term 'interactive professionalism', as noted earlier in Chapter 3.

Action Research

Action research provided the guidance and support we needed to become a learning community (group). This occurred because "the 'family' of action research has an uniting characteristic: it is done by teachers " (McCutcheon & Jung, 1990, p. 150). Historically, research usually was something done by theorists (researchers), who used teachers and schools as data collectors and sources of data. In the past, this
arrangement created tensions for both theorists and practitioners. Teachers often viewed research as something distant for others to do. Research done this way was often missing certain elements endemic to the classroom. Campbell and Campbell (1999) point out:

Teachers are not immune from theory generating. To make sense of student learning potential they encounter daily, teachers construct beliefs or scripts about the intelligence of those in charge. These implicit beliefs can be optimistic or pessimistic, constructive or expansive. For the most part, they are seldom verbalised, usually unconscious, and may work against student's welfare. (p. 4)

In our study we sensed the need to relieve tension by telling our stories of action and reflection by keeping journals, reflecting and verbalising our tacit knowledge, for instance Cal wrote in his journal April 15th, 1998:

I now have a better understanding of the people I work with and now I know why some are so different. Pat is new. But I now know why her reactions to what has always been done here seem so unsupportive. She is unlike Bob and Jan who see it as I do — business as usual — another day at the office but we are moving all the time. Each change I make feels good, as I share it with others in our group. I feel supported and I support in return. I wish we had more time for our [action research] project but with Bill 160 and less prep/more students we will be busier than ever — maybe I'll give up coaching and then I'll be assigned as a guidance person when the new program starts in 1999. (p. 40)

Cal's insights allow us to see how his initial understandings were changing. He suggests, near the end of our project, that his fellow participants are more familiar to him. He now appreciates the cause and effect of participant contributions. Cal's disclosures and observations bring clarity to our study and allow him to vent his feelings. His journal entries provide perspective (wish for more time) and aid us as
we improve our praxis. Our theory about Cal's actions (give up coaching) is more informed as we hear Cal's voice. The process has been a learning experience as we reflected, acted and supported one-another. Nonetheless, we realised that our limited resources meant limited growth, as Altrichter et al. (1993) point out:

Teachers, of course, have a disadvantage as researchers in that they cannot dedicate very much time, energy and money to elaborate research designs and methods. However, teacher-researchers also have an important advantage. All forms of educational research rely upon testing ideas in practice as a means of establishing their validity. (p. 208)

To expect Cal, a busy teacher, to produce a lengthy detailed journal, while maintaining a busy interview schedule, was a lot of added responsibility. So, when I read Cal's journal with 'thick' descriptions I appreciated further his participation. For instance he wrote, "my time is limited, I'm tired and it's Friday -- this weekend we travel to a tournament, so I'll have to take some marking with me -- I don't get any money for gas -- but I enjoy these events" (October 10th, 1997, p. 1). It made me even more determined to support and facilitate our project.

Relationships

It has been said, "action research is carried out by people directly concerned with the social situation that is being researched. In the case of the social situation of a classroom . . . " (Altrichter et al. 1993, p. 6), relationships with others are often of concern. Concern for relationships in this study meant attending to feelings. The mere act of observation and examination in the process of realising action research
goals brought about many feelings. In our study, like many others, "feelings of being threatened stem from the pressure on teachers to reproduce ideological conceptions of practice which legitimate the hegemony of the state" (Elliot, 1991, p. 115). The state, in this case, was the Ministry of Education and Training and its expert panel reports that supported a move towards child-centred assessment, and a move away from mostly teacher-centred assessment modes. However, Cal adds during an interview:

I think that getting yourself too worried about the facts in the Ministry guidelines causes anxiety. I think teaching the process of science and thinking skills of science is important -- sure the definitions are important but how to apply science is important too. (March, 4th, 1998, p. 2)

I recall this exchange. I thought at the time that Cal's tension could be reduced by simply changing his perspective concerning the implementation of the guidelines. Cal was not going to worry about details because he thought any change could be minimised by what he chose to do in his classroom once the door was shut. Sure he would have to hand in customary pieces of paper that provided one version, yet implementation via his actions was something he felt he could maintain. No matter what is detailed in the guidelines, teachers bring it to life. So, there is a good chance that no two educators will do this in the same manner, so why be overly concerned about a piece of paper (guidelines). Still, our collaborative attention to the expert panel reports, assessment theory and praxis caused participants some anxiety, as it does for most educators (Hargreaves & Fullan, 1998).

Other tensions evolved due to the very social situation created by action research
(public attention) as participants disclosed values, beliefs and offered support and help to fellow participants. As the communicative climate took hold relationships unfolded. Many feelings could be sensed, as revealed in section 6.10 (above).

No matter how good the relationship was, Cal and I became aware of the fact that we shared different understandings as we progressed through this enterprise. As is often the case in relationships, we realised the extent of our differences in areas that included our level of understanding, actions, needs and goals that, upon reflection, were often causes of tension. For instance, Cal thought he could continue to do what he was doing and I suggested he would have to make changes. In the end I agreed that he probably could continue since there were no 'curriculum police' and the administration is busy in other areas. I knew this because I am a teacher who has been able to stay the same year after year, in some areas, in spite of changes in the system. Educational change in theory (on paper) is much more efficient than changes in practice (actions) because little attention is given to the monitoring of classroom practices in most schools. Elliott (1991) adds:

The emergence of a reflective practice is both a critical and creative enterprise. It is critical because it involves a critique of the ideologically distorted components of teachers' self-understandings in the light of their reflections upon experience. It is creative because, in attempting to resolve dilemmas in their self-understandings, teachers develop new ways of understanding the relationship between educational values and their practices. (p. 115)

Even though Cal and I agreed that the goal of education is to produce good citizens, it was less clear to both of us how we would work towards this outcome. I would have a student-centred classroom and Cal would have a mix of teacher-centred
experiences and student-centred ones. We could probably work together but our list of things to do would be two very different lists. I use a student-centred approach as a means of discipline and Cal uses himself, as noted in the November 27th, 1997, excerpt.

T.R. I noticed in your classrooms—you were away from students behind the counter most of the time.
Cal - You know what; I normally don't do that - It might be because when you were there they were nervous - for me, normally they don't do that - for me I usually walk around to maintain behaviour. (p. 1)

I believed this situation was a throwback to a different era where the teacher ‘patrolled’ rather than sought to engage students. It often happens when a teacher is too busy or unable to do otherwise. This mode of discipline is sometimes essential; I even do it myself from time to time. Yet, sometimes, if students are focused on novel, authentic (see section 2.3), and self-initiated activities there are fewer and less severe discipline problems. Another source of tension emanated from my role as facilitator that instantly gave me special status, which I was aware of and attempted to resolve many times during the life of the research. I would remind participants that I, too, am a secondary science teacher who would return to teaching after this leave of absence. Cal wrote in his journal:

I don't have the answers but I want the answers, and if I have to sit around during an interview is the price I have to pay then so be it. Reflection is nice but at some point we need to do something about it — it could be I'm just too busy to go and get the answers and I thank Tom for his effort — the Board should be doing more of this too. (October 12, 1997, p. 3)
I appreciated this sentiment; it was supportive and allowed me to reciprocate easily. I knew Cal could have concealed many of his true feelings from me. Yet, I addressed this possibility directly and discussed it with Cal openly. Cal assured me he would say whatever came to mind.

Cal thought the system needed to be fixed; yet no one seemed to ask for teacher input. Cal wrote on February 1st, 1998, that:

I have just put the finishing touches on some new peer-assessment forms and I think these will be useful if the students take it seriously. The best plans don't always work, as it's easier to stay the same. I get a little more hopeful on weekends because I have time to think about what's possible based on what happened last week and last term. (p. 20)

Weekends are often a source of tension for teachers as calm deliberate reflection away from school and the classroom permits us to see where we can improve and planning is guided by past events. The only factor to throw up an obstacle is the unpredictability of the students during the upcoming week. On February 4th, 1998, we discussed student relations, another source of frustration for Cal.

T.R. To what extent do you think your job is motivating?
Cal - A lot more due to home life[of the students]. The system dwells on their feelings to the extent that they can't fail and the kids know the system and they will push it as far as they can just like the young offender's law. It will take a long time to reach the point where kids assess themselves well and it is part of the curriculum. (p. 2)

Dilemmas were identified during the life of our project and I often facilitated reflection, which Cal saw as necessary yet time-consuming. Elliott (1991) explains:
On the basis of my experience as a facilitator of educational action research in schools and classrooms I would assert that this self-reflective process always involves teachers clarifying the nature of the dilemmas evidenced in their practices and the ambiguous self-understandings they manifest. (p. 115)

As Cal clarified, he realised the benefits of action research and had a better understanding of the obstacles and materials necessary if he was to overcome and improve his assessment praxes. Tension is further addressed in later chapters.

6.11 Assessment Praxes: Perspective Transformation

To review, in our study each participant’s ‘actions’ could be labelled either conversation or practice. As a result, 'action' was viewed in relation to the evidence. I looked for causal relationships and when I could not find any I theorised. I viewed it this way because “action by itself is directionless and reflection by itself is aimless” (McCutcheon & Jung, 1990, p.147) unless it can be linked to something. We moved in a particular direction or directions due to our reflections, which impacted on our actions (praxis) in many ways. Sometimes these reflections gave way to a means to solve problems (Schon, 1983). For instance, as noted earlier, participants generally were not as aware of current assessment policy or practices at the Board or Provincial level. In Cal’s case his actions in our study allowed him to gain more self-awareness about his assessment praxes. This new perspective and level of assessment literacy resulted in certain actions. These actions caused Cal’s assessment praxes to change. Our group was improving due to our conversations (reflexivity), group discussions, document examinations and feedback. Specifically,
he used more exemplars, tried to involve students more in the assessment process and was able to determine useful attitudes which supported the development of performance assessment tools. These changes were caused by growth in both theory (reflections) and practice.

Cal's initial views of assessment (function) were predicated on the assumption that he needed to control student behaviour. Tests, he maintained, caused students to pay attention in class by providing feedback and creating a desirable emotional (anxiety) tone in class. Students were more focused because of the impending assessment. Cal used the threat of assessment as a disciplinary class management tool. He was the sole assessor, but was interested in moving towards a more shared means of assessment. His assessment was efficient, meaning that it took all the free time he could afford and usually targeted knowledge, as this was the easiest student capacity to assess. Validation was mostly face-validity and usually was limited to his own judgement.

Cal saw himself as an experienced teacher who had learned from interaction with his students. He was a life-long learner who had learned to ask better questions of himself and his students. Cal noted that he was a traditionalist, in the sense that many of the assessment elements within his praxes were inherited from assessments he had encountered in his past. However, Cal wanted to learn and to develop his assessment praxes, and he was frustrated by the government intervention (Bill 16C) and the Board's alternative agenda, which he believed, reduced his ability to meet his assessment needs. Cal often mentioned how our action research efforts were
helping him to change. He told us the study was helping him to reflect on what he was currently doing and motivated him to speculate about his assessment praxes in the future. But, sadly, he stated this effort was not something he had previously encountered in his 12 years of teaching.

Cal believes that he assesses better today because of his experience with this study, and wishes he had more time to meet with colleagues and prepare assessment tools. On several occasions, assessment terms that had not previously been used in Cal's school, or at least not within the conversations that Cal had, were introduced, defined and applied. For example, terms such as exemplars, exit outcomes, performance assessment, authenticity, construct validation, targeting and portfolios, once unknown or misunderstood, became part of his vernacular. This knowledge gave way to a better means of communication and caused Cal to step forward and assert his new found assessment literacy both in the classroom and in the meeting rooms.

To support these claims, I am suggesting that Cal was always open to new ideas and ways of looking at questions. He was aware that teaching was intrinsically challenging and required on-going learning in order to improve.

T.R. Do you have to improve in assessment?  
Cal - I need to work on my questioning, verbally, and on tests, and ensure I'm fair. I have to use a lot more hands-on activities. We've worked together in the past but staffs are self-conscious and it gets in the way, as well as time limitations. I'd be concerned with the critical feedback.  
T.R. What about opportunity to learn?  
Cal - Well I learn something every day. And if you don't, you are not risking enough. (March 4th, 1998, p.1)
Cal had a personal philosophy that was evident in our conversations. His theorising informed his practice and it was this theorising that led to some refined praxis. Cal was changing. I noted it in his later communications; his tone (non-verbal) seemed firm and his sense of purpose heightened. He had begun to accept the limitations of the typical content-based teacher-centred assessment praxes. He began to favour a more outcome-based, student-centred assessment style, where students take ownership, are empowered, and take responsibility for applying higher-order thinking skills as part of the curricular experience. Cal began to adopt and modify his assessment theory because of our focus on assessment praxes. He asked more questions about peer and self-assessment and his lessons became more assessment focused as this study progressed. For instance, he began to use exemplars more frequently and shared examples with our group. Some of these, such as the spaghetti towers (structures) and floating golf ball (buoyancy) models were quite creative. Our group was supportive of this practice and praised Cal's efforts in our customary supportive manner.

In sum, while this chapter has provided some information concerning questions one, two, three and four, the remaining questions will be addressed in later chapters (10,11).
Chapter 7

Bob: Past and Present

Introduction

Bob and I discussed assessment on several levels. All were in some way tied to the personal, professional and political elements of his praxis. First, I viewed Bob as a teacher who taught in a classroom. Second, I was able to get to know Bob as a person, who had been assessed as a student at all levels of education. Third, I saw Bob as an administrator, as he was the Science Department Head who had to oversee certain assessment guidelines as issued by the school and Board administrators. Fourth, I became aware of Bob as a guidance counsellor who examined student records and counselled students. These roles proved to be difficult to keep separate and often distracted me from my immediate task. For instance, I was quite fascinated with the pressures within the guidance department as students competed for entry into a chosen University. Some students even visited the office for socio-emotional reasons. I tried to stick to my agenda (Appendix C) and Bob to his (professional development of assessment for the 1997-1998 school year). My roles where many and caused me to doubt and reconsider the process many times; it was the same for Bob. Bob had to maintain many responsibilities during the life of this research project. For example, he was a colleague, teacher, action research participant, science department head, basketball coach, and a guidance counsellor who involved himself in other committee work within the school and at the Board level. So, when Bob and I talked about assessment targets, the conversation
contained evidence from other contexts. These contexts often took us in other
directions and ranged from classroom assessment praxis (professional), department
praxes (political) to the assessment praxes of various staff members (personal).

The features of Bob's assessment praxes became themes in this chapter. For
instance, our discussions addressed Bob's assessment influences (past, present),
modes (forms), targets (functions) and needs. We illuminated aspects of his
assessment practice in relation to many issues such as isolation and autocracy. In
doing so, tensions were noted and detailed in section 7.5. Throughout our journey,
discussions revealed a great deal about the beliefs and values held by both Bob and
myself. I learned about myself by talking to others while presenting certain opinions. I
illuminated and sharpened my own thinking. Our aim, like many action researchers,
was "... to transform the present to produce a different future " (Carr & Kemmis,
1986, p.183). As will become apparent, change is easier discussed (reflection) than
implemented. The chapter concludes with observations concerning some of the
changes in Bob's assessment praxes as well as his evolving perspectives as a
teacher, department head and group participant. As a result, research questions one
through four are addressed in this chapter, whereas five, six and seven are dealt with in
later chapters (10,11).

7.1 Assessment Influences: As a Student

As we began to reflect, we knew that teaching was much more than a set of technical
skills, for it had an ethical and political history which contributed to its present form
and function (Carr, 1995). So, as we began there was a sense that we had a lot to do. Bob was eager to dive into our study; he never took longer than a minute to respond to any question or issue on the table. Bob was a leader (Department Head) who used an honest and candid manner to deal with most events in our study. He recalled how he viewed assessment as a student. This reflection occurred in his guidance office. Like most educators today he had to work in more than one department. Bob had chosen to work within the guidance department for one period each day and we often met in his guidance office during our one-to-one interviews and group discussions. The office was quiet and contained newer comfortable furniture (chairs). This made it easier to focus on our task at hand. Quite a change from the hard science stools of the science classrooms. Our conversations were captured on audiotape and proved to be the 'glue' for maintaining the integrity of the group and individual relationships (Feldman, 1999). When the tape was rolling, each participant seemed to have more presence and sense of purpose, as if they were on stage. The effect did lessen but I found that we were, during the onset of this study, aware that our words were being recorded. I felt the stakes were high and if technology failed we could lose a great deal of time and effort. It made me anxious, so I prepared for problems in advance. I had a back-up tape-recorder, tape and a few mints to hand out to participants to get the exchange going. These measures seemed to work well, as we had no setbacks.

From our first meeting onward, Bob had many strong memories of being assessed as a student. It is through these recollections and reflections that many of our research
questions were addressed. Specifically, in this section I address Bob's initial understandings of assessment and actual practices at the onset of this research. Further information dealing with the same research question is contained within sections that follow.

From the very beginning of our journey, Bob often reflected on his days as a student and recalled assessment as he had come to know it. In an October (1997) interview Bob explains:

> It was always to the test, like it was the measure of how you were doing, nothing else, you were doing labs and stuff as I recall. (p. 1)

Bob remembered learning material that would usually appear on the next test, and this cycle would repeat itself regularly. Today, this type of teach-test-teach cycle is frequently maligned by critics, who favour a more comprehensive performance-based curriculum that contains greater assessment depth and breadth (Earl & Cousins, 1995). Even Bob's Board and school administration favour and urge assessment changes (Appendix E). While we discussed the assessment praxes in today's classrooms, I asked if it was the same as when Bob was a student. Initially, Bob said he felt that assessment practices have changed since he attended secondary school, but then he added, "... probably not, probably that's the basis of how we assess," (October 1st, 1997, p. 1). So there appeared to be some uncertainty. Bob would later write in his journal:

> I have little time to write down my thoughts during a day but I think the questions we discuss are creating anxious buttons for me. I can see
how much work I have to do to catch up; to even stay up to date is scary. As we make our way through this project I suspect we will need to pull together to realise some success. Assessment has been something I do, not something I look back at. Our group will help me with this yet I feel I need to lead. (p. 3)

At first, I was puzzled by this entry and ready to dismiss it as just a nice sincere thought. However, it made sense when I looked at it the third and fourth time. This was a significant starting point indicating that Bob was uncertain and unclear about his role and assessment praxes. The issues required further reflection. When Bob suggested that he had been urged and advised to get away from past assessment practices, he spoke of the Board's guidance (Appendix E), which endorsed equity, variety and student-centeredness. The problem was not where to go with assessment but how to get there from his current position with no inservice in sight, other than our study. Sure, it was noted on Board memos that there would be workshops and inservice but Bob had not yet experienced it and was not expecting any. Bob later wrote:

I was aware of the amount of change going on this year but it seems to be mostly on paper. Everyone is overworked and even the best-laid plans are not being realised. Bill 160 is not the solution! (April 11th, 1998, p. 44)

Bob, as the Science department head, was meeting with other heads to discuss Board policy and practices, whereas other participants in this study did not have this administrative role or perspective.
Preservice: Experiences

As we met in the guidance office I noted the pictures on the wall. They were of Bob's basketball teams over the years. He was a successful coach who was very respected by both players and other coaches. I learned this while talking to other staff. On this day, Bob began the interview by speaking warmly about his days as a University student. He talked about learning a lot and looking forward to teaching. These were exciting times, full of promise for both of us as we exchanged stories and laughed at our similar insights. We recalled living in residence and going to parties and going to classes that seemed quite distant from the reality we now knew as science teachers. I probed carefully to locate assessment influences and experiences.

T.R. - Was your Faculty of Education experience useful?
Bob - I thought it was useful in the sense that it's necessary and I learned a lot. I don't think I learned it from the faculty, but the year's experience taught me a great deal through the practicum and associate teachers.
T.R. - Was the theory as useful as the practical?
Bob - I don't think so. The theory needs to be up to date, and it wasn't. (February 4th, 1998, p. 3)

Bob's perspective was interesting as he noted the importance of the practical experiences he had as a preservice teacher. Yet, he suggested the theory was wanting. This seems to be the case for most preservice teachers who "... usually view teaching as something one does, not something one ponders " (Wideen et al. 1998). So, confronted with this 'wanting' theoretical direction, he chose to assess in the same way he had experienced assessment as a student. Coincidentally this is the way teachers assessed when he arrived at his present school. He was assigned
classes and given binders complete with course materials and assessment tools. At the time, he saw fellow teachers’ support as helpful. However, now he suggests it may have been a way to ensure he did what they had been doing. Still, in his preservice he later explained that he learned most from the teachers who facilitated his inservice, yet these teachers were probably using traditional assessment paradigms. Thus the propagation of an assessment tradition. Bob noted in his journal:

Assessment for me is something I have to do. I follow a plan that is really controlled by the amount of time I have. I use tests that are already prepared and I hope they are good ones. I realise I should do more—I just find that the time isn't there. Our action research group may be a way to change this but we have to sort out a lot of issues like how much of a shift is necessary so that students are more involved in assessment and what would this involvement look like. (November, 5th, 1997, p. 5)

Bob saw himself being caught in the momentum of the school year as his timetable dictated his direction and placement throughout the day. Life was hectic! Bob felt it had been this way since the beginning of his preservice. His life was dictated by a schedule of classes and responsibilities related to those classes. He viewed his teacher preparation as a launching (Schoonmaker, 1998) and there was little opportunity on the job to stop his journey in order to slow the pace down. Bob was caught in the current, however he had demonstrated an ability, at this point in his career, to reflect and critique his praxes. What remained was the task of nurturing this ability in order to make changes in his praxis. I saw this task as one of my roles.
Inservice can be a time of finding out what works and what does not. Once in the field, many teachers pick up tips and solutions by discussing theory and praxis with other educators. To do this, a teacher needs time and opportunity to interact. It may have been possible in the past, however, given the current morale of secondary teachers in 1997-1998 school year it was not an easy task. Teachers seemed too angry, frustrated and tired. For instance, over the years Bob had been given more responsibilities and received less preparation time at his current school. Given his intense schedule, Bob had to cut preparation corners and repeat what he did the previous term or year; hence the routine became an obstacle to change and interaction. As noted earlier, when Bob arrived at his current school course binders were given to him that detailed a typical content-based program complete with dated assessment tools that seemed to do the job. Once he was using the binders it was almost impossible for him to reinvent or reshape the courses, given the lack of time and support available.

Bob often mentioned that he needed help and time to ‘weed his garden’. Later he mentioned that he needed professional development in assessment beyond what this study could provide and I encouraged him to pursue this via inservice opportunities and coursework. It seemed to me that Bob had reached several milestones in our study. He reached these milestones because “... it is only in articulation that the teacher becomes fully aware of the existence of what has been tacitly there as theory
and is then in a position to reflect on this newly uncovered theory " (McCutcheon & Jung, 1990, p 144-145). I sensed from the onset of this study that Bob had been under pressure to change in some way. Smith (1986) adds:

Most teachers do not have a good theory of learning and teaching. What they know is what they have been taught about the mechanics of teaching. And when they are in doubt, when they are under pressure or losing commitment, they stay with what they know best. (p. 150)

Bob was under pressure. Many, if not all secondary teachers this year felt it, due to Bill 160. Bob had to manage his Department, a curriculum council, coach after school, work in the guidance Department for a period a day and teach his science classes. So when he aired several revealing admissions during a discussion, I was sympathetic.

Bob - I never remember what I did the year before because I never write it down. That's just me — the problem is that you fall back to that position rather than try something creative or new. My binders are just security blankets. (April 9th, 1998, p. 4)

This admission provided a window through which I could begin to understand Bob's praxes. From here we move to the present.

7.2 Current Assessment Issues and Methods

Our October 15th, 1997, group discussion revealed some of Bob's tacit assessment knowledge, theory and rationale.

Bob - We're all so recently out of University. I think we would have a pretty good handle, I guess, what senior classes now 12 and OAC, what
a University level course would expect from students. When I teach my OAC Physics class, that's got to be, if it's not number 1, it's number 2 in terms of assessment. I'm making sure I show them how to perform at the University level. I think, this past weekend there are kids back from University. I'm constantly getting feedback. The University students were back from school and getting feedback as to what their courses are like compared to University. I think that has got to be a key driving force. I mean an OAC course is there because we're preparing them for University. Maybe it's redundant, I think to a certain extent that's a priority for us. I don't want to change a whole lot in terms of their assessment because I know how they're going to be assessed at the University level.

Jan - That's in terms of testing, labs and assignments.
Bob - Exactly, so I mean, I know in University there's a weekly quiz, lab, assignments and they're going to have tests of the format that I'm using. So, I mean, I don't want to stray too much because I want to give them as good a preparation as possible.
T.R. - And at the grade 9-10 level we can't say everyone is going to University.
Bob - That's right and that's where we have to do a better job of varying the assessment tools. We've started that in small ways, but we have to look at various techniques for that level. Obviously more self and peer-assessment could help as could more application tasks that would naturally be lab oriented. (p. 4)

I thought to myself as we discussed these points that we can't say all OAC students will go to University. Our work together caused Bob to reflect; and as a result, sometimes this led to uncertainty for him. On this occasion, Bob's reflection was an explanation of his position on assessment. He suggested that he would do as the Universities did in order to prepare the grade 13 students for University. Bob was teaching about University assessment traditions. I recall my organic chemistry class that had no laboratory work whatsoever, it lacked application experiences and was completely theoretical. Many of my assessments were multiple-choice and were very much meeting the needs of instructors rather than those of the students.
I believed that 'change', or the threat of it, was unsettling for Bob, he wanted to retreat to comfortable memories of the past. He was already overworked and the notion of a disruption was stressful. Thus, he was continuing a tradition of assessment. So, change was the issue here and not uniformity of assessment between one level of education and the other. Bob viewed being different as something less valid and less credible. By doing what others were doing, even if it was at another institution for adult learners, the status quo was ensured. However, my reading of this rationale changed once careful review of the data was complete. Bob noted in his journal:

Does it matter if the assessment changes slowly or quickly? I don't want to move too fast, because, if I do, I will miss the most important features. We never did get the expert panel reports. I am not aware of these or the latest research and theory of assessment but what I need to do is move carefully. (October 12, 1997, p. 4)

It seemed as though Bob was saying that he needed more professional development (action research) and time to enact assessment changes. It seemed reasonable to assume that secondary assessment needs be linked to the course requirements of the secondary school and not to a post-secondary education. I noted in my journal on December 15th (1997) that:

Each time we meet I'm impressed by the seriousness Bob brings to the table, as he is a leader both in-group and one-to-one interviews. His tone injects a greater sense of purpose into our project and for that I am grateful. (p. 15)

Bob was enjoying the opportunity to speak about his practice. He knew he had to do more and move away from some of the traditions he had maintained. Bob soon
realised:

Teachers must not only pass on information; they must also pass on a critical habit of thought. They must positively encourage their pupils to find out for themselves whether what they are taught is true. They must consult their own experience to test the traditions, which are handed to them. (Peters, 1959, p. 101)

Bob was moving. He was shifting his emphasis. He moved slowly from his need to deliver content to a point where his students' needs to reach expected outcomes were prioritized, yet we still had to examine his initial position more thoroughly.

Bob used a content-based program (Griffin, 1998) that was complete with assessment tools (Appendix M), that usually demanded students only need to have a grasp of the text. We talked about the narrowness of the course and the use of numbers to indicate student progress, achievement and identity. Bob was eager to point out the assessment problems and through our discussions we often resolved issues, or at least made things clearer. One such issue was that of administrative directives. Often they seemed to suggest that teachers do one thing (provide report card percentages) when, in fact, teachers were doing something that was completely opposite (moving to varied and alternative means of reporting). This situation arises because administration is often unaware of the specific activities in the classroom. This occurs because there is not enough time for Board administrators to visit each school frequently, let alone each classroom or staff member. Personally, I have not seen certain administrators for several years and I have not had a classroom-based teaching evaluation for over eight years, even though I have requested it. Bob echoed my concerns and similarly critiqued his administration. The following provides
some insight into the paradoxical realities of teaching and addresses one of the research questions: 'what was the current state of assessment practice in secondary science?'

As a beginning point, for instance, Seeley (1994) reports:

> This day's teachers are receiving many mixed messages about assessment. For example, teachers are encouraged to use a number of types of alternative assessment to guide instruction and monitor student thinking. How can all this information be recorded in a single letter grade?

This seemed to be the case in our study as the mixed messages came from the Board. The Board suggested "assessment . . . should include a wide variety of strategies and methods" (Appendix E), and yet the 'width' is eventually eroded to a point where two single numbers represent an exit point (Report Card). We felt that all our assessment efforts would be unnoticed in the end, when reports came out that used only percentages. We eventually decided that our efforts would serve the students best, as it is their achievement and development that is really important to us. Still, we theorised that these mixed messages and confusions cause teachers to retreat from assessment change efforts. In Bob's case his retreat had been very gradual. So gradual that it wasn't until our study began to unfold that Bob realised the extent of his isolation (individualism). This isolation theme kept appearing as we discussed his assessment praxes. For instance on October 8, 1997, I asked Bob:

> Are you the sole developer of the assessment tools?
Bob - Yes, at this point.
T.R. - Does this individualism cause problems?
Bob - I see your point: What can I do? I'm the only physics teacher.
Bob usually worked alone because no one else taught physics, at least this is what he suggested. However, I pointed out that all teachers assess and that together we need to support and grow. Still, Bob wrote:

Since I have been at this school I have been on my own as far as Physics goes. It seems that I only have enough time to maintain what we are doing and changes usually come from the top down. The control seems external and it is frustrating, as I do not choose my path it is chosen for me. (January 21st, p. 24)

During an interview March 26th (1998) Bob continued to reveal his concerns, when I asked:

Is it important for us to meet, as we are now to discuss pedagogy? Bob - Oh, for sure, as I just said it's impossible to meet like this because there are so many other forces driving us, staff, department meetings that cover all this other vague stuff that has nothing to do with your teaching. Cal and I have to spend a day out of class Tuesday to go down to the Board Office. It actually did nothing for me, maybe 15 minutes to do rubrics was good but that takes a lot of our time, whereas we should be using our time to do something meaningful. (p. 3)

I considered our time discussing assessment a valuable investment, However, Bob was pointing out that the issue of quality during inservice and the best use of time to achieve certain assessment literacy goals was also key to certain outcomes. Bob was frustrated with the inservice. So, he would go back to class and focus mostly on the paper and pencil tasks, which were efficient and yielded the quality and quantity of data most useful. Hence he ignored inservice suggestions. Bob spoke about his current dilemma:
Anytime you try to make improvements it takes time. Any improvement you try and make in your class that is not something supported by others [Administration, Board, and Ministry] you will be forced to abandon. Either the Principal or the Board is going to have their little projects, infusing gospel values, which is important, or things they want you to do so that they can justify their own positions. And it’s unfortunate that takes a lot of time away from us that we could use to improve our own programs. (March 26th, 1998, p. 3)

Bob believed in change. Yet he felt that the most successful attempts were the ones that began at the top and trickled down the hierarchy. Still, Bob had experimented with peer, self and social skill assessment, but did not believe these experiments had been successful, largely because of time limitations and, like Cal, the belief that students were incapable of doing it. By participating in this study, Bob was attempting to improve his assessment praxes in the company of teachers and not in response to a distant administrative force. We discussed several assessment (forms) targets such as authenticity (see section 2.3), variety and student-centredness. Bob and I both knew 'student-centred' education was not new, it was however a move towards placing emphasis on the interests and needs of the child (student) in order to facilitate the student's assimilation of knowledge (Peters, 1959). Bob was looking carefully at targets and modes of assessment:

I don't know if you can assess creativity, but you try to give them opportunities to be creative. I know in my grade 12 independent study for my grade 12 physics it's a paper, and I hate papers. I give them an opportunity to do a demonstration, a computer simulation, build a model of something. Anything other than a paper—it's a risk/reward situation. They are taking a risk by doing something other than a paper, and I told them a reward would be there, maybe marks wise. We can work something out there. I don't know in assessing what they are doing. I can mark their creativity but, hopefully, I can encourage them to be creative on a different topic other than a paper. (January 7th, 1998, p. 5)
Questioning current practice and working with students was a first step. Giving consideration to such capacities as creativity in science is another step towards more holistic assessment praxes. I believed we could make changes yet I sensed that our progress needed to be at an acceptable pace. Bob wrote in his journal:

I find the effort to change is less when we get together. Alone it seems too overwhelming a task. I need to meet with others more often to reform my assessment. This is something we could do at curriculum council. I really wasn't aware of how different each of our assessment schemes were until we started to compare them. (November 6th, 1997, p. 7)

There was a need being met here. Bob was realizing that talking about issues moved him to clarify and identify a path to take. He realised that working together facilitates this. As Hargreaves and Fullan (1998) note, when teachers work together, they "build collaborative cultures of reciprocal learning among themselves and with their students" (p. 43). In the traditional, teacher-centred mode, assessment was often a way to arrive at, and supply a number for a report. Further, "... teacher-centred classroom control actually worked to deny student responsibility for classroom climate" (Carr & Kemmis, 1986, p 169). In today's classroom, assessment can be viewed as a means of ascertaining student growth, progress and achievement co-operatively (student-centred). This paradigm shift is something that Bob and I discussed. We struggled to come up with a means of illustrating achievement that was both efficient and authentic (see section 2.3) in physics. Bob wrote:

If I make the assessment too student-centred I may turn the course into
something I would not like. I think the students should do more to assess themselves but first I need to lay out some assessment guidelines and make sure these work. I need administrative support and time. (December 12th, 1997, p. 14)

I didn’t really know if this entry was another attempt to stop the process or to just slow it down to a slower and more manageable pace so it would be successful. At least we were moving forward and not static. As we met in his guidance office it seemed that Bob could only talk about students in terms of their grade:

Bob - During the semester, I find, inevitably, if I was asked by a teacher or parent, or by that student, how they are doing in the class I think I fall back to their marks. I find it very difficult to get beyond the marks to determine what their understanding level is in the course. I think that differs from the class. I think I would know if the class understands a concept, but I think the individual student, who has 70 percent, then they understand but if they only have 40 percent then they do not understand.

T.R. Why are you assessing and judging?
Bob - I think I'm getting feedback about how they're doing in the course. I think the best I can do is get feedback; I guess, to a certain extent I am assessing to find out more about each student than the class.
(October 8th, 1997 p. 1)

Bob spoke about his need to move forward and change his assessment praxes in favour of a more comprehensive, fair and shared assessment, yet he required time to reflect and illuminate his present praxes. He noted in his journal, "... talking about assessment makes me look at what I am not doing, so I will have to make a point of getting more information and examples of different kinds of assessment " (October 12, 1997, p. 4). We then discussed the assessment needs of students:

T.R. - How do you know when a paper and pen assessment is not treating a student fairly or is not the best way to assess that particular
student? Secondly, will working alone create validity concerns? Bob - Well, first, the obvious case would be where they have an exceptionality that would hinder them on a pencil and paper test. I'd have to search for that. Second, I don't have anyone to work with in physics, so I am on my own. (October 8th, 1997, p. 2)

What was striking about Bob's reflections in the early part of our journey is the fact that he operated in such complete isolation for the most part, with no other professional educator really taking the time to observe his assessment practices at any point in the year. Yet, I knew from experience that this situation was not unique to Bob; it was widespread in education, I recalled. The opportunity for colleagues in the department, let alone the school, to become informed of one-another's practice was absent. So, due in part to this isolation, Bob assessed in a limited mode, using primarily pen and papers to assess, which is common in typical content-based programs. Bob assessed physics achievement, understanding, ability and growth of students (Appendix M) using mostly traditional modes that were applied routinely following a unit of study. Bob could refer students to the Special Education Department but this really was limited. Only those who scored lowest on assessments (less than 1% of the class) would get Bob's referral and the others were left to their own means, even though they could benefit from special education help. It was a question of resources and the special education department, like Bob, was stretched to the limit. Along the way we confronted the question of fairness, which highlighted for me the degree of individualism in Bob's assessment practices. Indeed, he stated many times that he felt isolated and needed to reach out but as of yet was at a loss to find a means to do so.
T.R. Who judges the assessment methods? Does the department judge your assessment scheme or the administration?
Bob - We all have assessment schemes that are dictated by the Ministry. There is a chart that each teacher in the science department would have and it gives you a range of where your assessment tools have to fit. So you may have a responsibility range of 0-5 percent, an exam range of 30-40 percent, and a test range of 30 to 40 percent, you know, as well, something like that.
T.R. - Do you follow Ministry guidelines?
Bob - Yes, I'm in that bracket somewhere in my range. I may be at a maximum in one range and minimum in the other, but I'm within the ranges and try to make sure everyone in the department is in those guidelines. (October 8th, 1997, p. 3)

I wrote in my journal.

Today we tried to find the 1987 curriculum guidelines to check for the prescribed assessment and evaluation percentages. Bob could not find them and was at a loss to remember if he had seen them in recent years. Eventually, through Pat I found a couple of parts of the 15 part series. I'll bring mine in so we can look at these. (Journal, October 8th, 1997, p 16)

This fact was of some concern since a single individual is limited in the number of good ideas they can generate. Still, most teachers develop theories based on their experience (McCutcheon & Jung, 1999) and therefore it is possible these theories severely are limited. Bob had become aware of one truth in education: If no one takes time to question current praxes then it is apt to remain the same. Indeed, all teachers are vulnerable to the dulling effects of routinization (Schon, 1983). Teachers are too busy with other paperwork, discipline and teaching to take on another important task in education, staying up-to-date. Bob had inherited a means to assess that worked for his predecessor and since the same guidelines were still being used he felt there was little need for him to have them close at hand or to
consult them. As far as Bob was concerned, his assessment praxes fulfilled all the existing expectations and produced a number useful for administration. He was not happy about it but saw his list of responsibilities growing instead of being reduced, as years passed. Bob wrote:

I have a need to back away from some of the things I'm doing now. I think the Department head and Curriculum council will be first to go. I don't want to resign from coaching but it would be nice to be in just one department again. (December 10th, 1997, p. 9)

Here was a source of tension, as I will discuss later. Bob was realising that in order to do a better job he would have to withdraw from some of his current tasks. This was difficult and Bob made no moves in this direction during the course of our study. Rudduck (1991) adds:

I would want to argue that most teachers, given the opportunity to reflect on their experience, would find some 'hurt' that routine or overload leads them to endure rather than examine. Consciousness of the hurt is most likely to recur as teachers refocus their professional values and goals, admit their political consciousness, and recognise any disturbing gap between aspiration and present experience. (p. 93-94)

Clearly this was the case with Bob and other participants. As we step away from the hectic pace of a day in order to reflect, we often find time to re-examine our feelings. Frequently, shared reflection, a key feature of collaborative action research, helps participants to articulate their own concerns in a supportive manner (Carr & Kemmis, 1986).

I moved onto Bob's belief that assessment should be a shared responsibility under
his concerned direction. Bob had made attempts to develop some self and peer-assessment tools, but these were used only infrequently in the 'lower' grades. Clearly, Bob's assessment role at the onset of our study was defined by his view that student-centred assessment is for the lower grades, where the stakes are less than in the higher grades.

T.R. - When you collect your assessment data do your students have any role to play? Meaning do you do peer or self-assessment? Bob - I don't do self or peer-assessment in a grade 12 class. I know if I were teaching a grade 9 science . . . that's something they use in the grade 9 science program and not grade 13. I haven't used that in a couple of years. (October 8th, 1997, p. 3)

At this point in the study, there was little doubt that Bob was engaged in teacher-centred assessment practices and had little opportunity to change or collaborate with colleagues due to current timetables. He spoke about the need of the department to meet before and after school more often, and mentioned that he would try to organise this in future. Following this meeting, I noted in my journal:

The thought of more meetings did not seem to go over well with Bob. Even though he made supportive remarks I got the sense that he was thinking he would have to stay here on weekends and do his homework. I could see that Bob was not looking forward to meeting more but it was at least something they could discuss. I didn't really think they would discuss it, as the strike in looming and morale is quite low. (Journal, October 8th, 1997, p. 12)

Eventually, I learned that Bob targeted and prioritised knowledge (the acquisition of it), though he did have other concerns. Bob addressed many reasons for the values he held and the practices he engaged in. For instance, during a one-to-one interview
I happened upon this disclosure:

T.R. While teaching physics, is your assessment directed mostly at the knowledge domain?
Bob - I think, to a certain extent that is going to form the basis of my assessment. I try to always have some application-type questions, so it’s not always straight knowledge. It’s trying to apply it to a new situation, to try to solve the problem. This would be the only deviation from a straight knowledge-type of question.
T.R. - Are doing a good job of assessing students?
Bob - I don’t know. If I think in a global way I am; in a local way I’m not. It’s very hard to get an assessment that’s going to tell me something about each individual student. I get good feedback. I think about how the class is doing. I think I have a good direction as far as where to go from one assessment to the next. I get good feedback about the class and then, based on that, it’s really hard for me to see where they are. I find that difficult. (October 8th, 1997, p. 1)

This excerpt comes from an earlier point in our journey when Bob was trying to understand his modes of assessment. He realised, later in our journey, that he would need to move away from some of his current assessment praxes in order to introduce more varied assessment praxes. Clearly, the support of the group facilitated this.

7.3 Assessment Modes: Examinations

Examinations have long been a fixture in the Ontario educational system.

Therefore, we discussed this mode several times in our study.

T.R. Will the upcoming exam show you anything new?
Bob - I am hoping it gives me a broader sense of the students' understanding and I hope that it’s not just a specific concept-in-isolation measure—it will show me what the students are going to carry forward from the course.
T.R. So it’s a knowledge focused exercise.
Bob - To a large extent, yes, it is.
What Bob and I knew is that these traditions in education were something we experienced and survived first as students and now as teachers who must administer and mark them. Indeed, "teachers are given responsibility without autonomy; they are expected to teach according to schedules of tests and examinations. The tests control teachers . . . (Smith, 1986, p. 150). However, Peters (1959) believes that "teachers must not only pass on information; they must also pass on critical habit of thought. They must . . . consult their own experience to test the traditions, which are handed on to them " (p. 103). So, I asked Bob about his examination (assessment) targets. I was hoping Bob might discover something further about his assessment aims:

Is it the application of knowledge?
Bob - Some of the questions are application style -- so, given this situation, what would you do? Also, what would your parameters be? A lot of the questions are application based but even that's a knowledge application.

T.R. What about labs skills? Are they considered at all on this exam?
Bob - Yes, there is a lab section on the exam. In the lab section, I give them a list of materials and a situation where they have to, using those materials, derive a procedure they would follow to figure out a quantity; they put in inherent sources of error; and they come up with their own experiment in order to learn about concepts and discuss sources of error and accuracy. (January, 7th, 1998, p. 1)

Bob's comments indicated a level of commitment to do his best. He didn't want to fail in his assessment of his students. This level of commitment is common in education today as teachers are increasingly confronted by test results which are claimed to be direct consequences of their teaching (Smith, 1986). It keeps teachers in line and supposedly more accountable. Yet "control through tests is lowering
standards and reducing expectations " (Smith, 1986, 150), as teachers teach to the test. I thought Bob was doing this. As well, exams have limited ability to measure achievement, understanding or application (Stiggins, 1994). Even the Ontario Ministry of Education and Training (1997c) has suggested: "There is . . . a perceived overemphasis on content: . . . there is an emphasis on memorisation, a focus on examinations, and poor retention over time " (p. 9). Bob wrote:

I am not a willing supporter of the formal exam but it is something most of the students will see in university so I feel I'm covering this base. I couldn't really move too quickly away from what I'm doing because it needs to be approved by the school administration — my hands are tied — unless we implement the expert panel reports tomorrow — I don't think it will happen. I look forward to a time when there is more student-centred assessment as it reduces my workload but if they don't apply the knowledge then they will still not be successful in my classes. (January 9th, 1998, p. 19)

Bob was doing what he had to do, by law, and that is, follow the directions of the Ministry of Education and Training. His actions might seem to support the status quo yet he was moved by our discussions during the first few months to question his continued support for exams. On January 7th, 1998, Bob and I questioned the integrity of the examination as an assessment tool.

T.R. - Is this fair?
Bob - Well, they have had 5 days of preparation, and they are aware of what's expected.
T.R.- Have you ever had an open-book exam?
Bob - Different skills, as all they have to do is look through their notes. You need different questions, too.
T.R. - What about a take-home exam?
Bob - I think there is an opportunity for them to use each other's knowledge and claim it as their own. (p. 5)
My reason for exploring assessment possibilities in this way was to add intensity to a discussion that really was difficult. It was difficult because we each knew that exams were here to stay, especially with the advent of the Education Quality and Accountability Office (EQAO). The assessment situation would get worse. I could tell Bob was tired and just wanted to get this over with as he yawned and reclined in his chair. Yet, he seemed interested at certain turns in our conversation, as if there was hope that someday this situation would resolve itself. I knew our conversation couldn’t go too far since Bob was doing what both the Board wanted and the Ministry of Education had mandated. On this cold January morning in Bob’s guidance office we continued to examine possible future alternative modes of assessment. I positioned the tape-recorder and pressed record.

T.R. Why not have alternative exams - like take-home or open book? Bob - I think you’re testing a different type of skill there. Basically, they have to look through their notes and jot it down. I think you have to ask a different type of question, too. I think in a take-home situation there is the opportunity for them to not only work together in a negative way. (January, 7th, 1998, p. 1)

From his answers, Bob was endorsing the belief that the current examination form was valid, reliable and, above all, a credible indicator of knowledge. I agreed somewhat, yet by promoting and maintaining the exam, Bob communicated his valuing of the knowledge domain to his students and peers. It was a comfortable practice and he saw no practical way to change it, given his hectic schedule and curricular guidelines. Still, these exams contained only a few word problems and had limited opportunity for students to perform a task which required the actual application
of theory to solve a ‘real’ (authentic: see section 2.3) problem.

T.R. Is it a very narrow view?
Bob - It's going to tell me what they understand and know, and how they can apply it.
T.R. So would this be similar to your high school exam?
Bob - I think my High School exam was mostly word problems and there was a lot of mathematical work.
T.R. Will someone's ability to comprehend the question impact upon his or her performance on this exam?
Bob - No, we have gone over the questions in class during the term.
T.R. What percentage will fail?
Bob - Well, out of 28 students, two will fail this exam I think.
(January, 7th, 1998, p. 3)

Bob believed the exam would demonstrate what knowledge students could apply. However, the invalidity of a final written science examination was something Bob understood. I pursued his beliefs by asking:

T.R. Why do we reduce the student to a grade, two digits, hopefully higher than a 50?
Bob - Well we're preparing and assisting in the development of the whole person. (January 7th, 1998, p. 4)

However, Bob's answers seemed unclear and tentative, as if he were seeing the issues for the first time or in a fresh light. If he was preparing the whole person, as he claimed, then a holistic assessment would seem a better fit than a narrow numerical description. It was an interesting moment as conversation led us to a point of discovery. Conversation has that effect sometimes since it "... can lead to action, follow action or be part of action. Through the intermingling of conversation and action, praxis comes about with its growth of knowledge, understanding, and theory through action" (Feldman 1999, p. 133). Each realisation that occurred via our
conversations provided opportunities for growth. A possibility of new understanding, hence there was some sense of wonderment as we conversed. The dialogue produced illumination and eventually led to certain realisations concerning the question: What was their (Bob's) level of awareness of current Ontario government pronouncements and in what ways did they (Bob) implement this knowledge?

To begin with, at the onset of the 1997-98 school year, Bob targeted knowledge and measured this using quizzes (5%), tests (30%), and an examination (30%). That constitutes 65% of the assessment in Bob's class. Bob noted in his journal.

I have to test a lot otherwise the students become less motivated or focused and seem less directed. In my OAC I test at least once a week and it comes on a Friday which works best as they will skip my class if I changed it. You need a hook to anchor them. I'd like to change this but how? I'll bring it up in our group. (November 8th, 1997, p. 10)

Bob also used 35% of his course for performance assessments (assignments, 5%; independent study, 10%; laboratory reports, 20%) The independent study (10%) was divided into an essay (60%) and a one-day exhibition entitled 'Science Olympics' (40%) (Appendix L). Our study caused Bob to examine these assessment praxes.

We returned to similar points time-and-time again and even by March 26th, 1998, we were still discussing motives for assessment. Bob explained,

My philosophy on quizzes is that you are taping the foundation of knowledge and you are building their confidence. You are using it as an introductory step and you're bringing them up to the test level on a continuum. If you were to challenge them more on a quiz you'd have kids who can't do the quiz and therefore you'd not be able to bring them forward. So what you do on the quiz is to form a base and move forward from there. (p. 2)
I thought that perhaps Bob's philosophy could be better served if he embraced the June 1997 recommendations from the expert panel in science. Students would benefit from a call for a more non-traditional assessment.

Alternative assessment methods, including journal, open-ended-problem, portfolio, interview, and performance assessments, should be used in addition to essay and multiple choice tests. Practical, hands-on assessments should be included, and these assessments should have an STSE focus. Authentic assessments involving evaluating the outcome of activities should be used whenever possible. (Ministry of Education & Training, 1997d, p.14)

However, one area not yet delineated by the expert panel was the weighting of certain assessments in science. It seemed clear that science would be assessed using varied methods in the years to come. Even Bob's Board had suggested this in their principles of assessment in 1997-1998 (Appendix E). Yet, Bob didn't have the time to make changes. He was uncertain how to make the changes without some professional development and support. Bob knew that Bill 160 would require him to move forward, change, and this was why he welcomed this study. He saw it as an opportunity, and later wrote:

Having support this year has been very useful and we appreciate the efforts. The curriculum council is looking forward to Tom's presentation and I'm glad I suggested it. (April 21st, 1998, p.43)

I was motivated by Bob's sentiments and told him so. I later applied for a regional teachers' union award for the group. Unfortunately my nomination was not successful. Still, Bob's needs were obviously greater once he became aware of the
expert panel's report, assessment research, and activities of other Boards. Bob was not aware of the direction assessment was taking. He was unaware of the degree (form) or emphasis (function) of the changes. (See: Comparative analysis - 1987 guidelines and 1997 expert panel report - Appendix Q) Also, because Bob was not aware of the expert panel report there was no attempt to initiate, prepare for or implement current government pronouncements until our study began. So, as a result, Bob and I reflected upon the need to communicate with others, and keep informed of government initiatives, as part of a professional development program.

It seemed that Bob’s realisation of his isolation and unawareness magnified a need to change. Bob’s initial understandings and actual practices began to change due to our conversations. During one discussion Bob agreed that communications with colleagues was important both outside and inside the classroom. We talked about the need to communicate, especially concerning each other’s assessment intentions. We saw assessment communications with staff and students as a key to successful assessment. Bob then showed me how he communicated his assessment intentions to students. It was in the form of a course outline at the beginning of each course and not via exemplars.

T.R. - Do you ever discuss what the target is with the class? Bob - On the first day that they come into class they are given a number of pages. It gives them a breakdown of the percentages in addition to each of the percentages. I'll give them a paragraph explaining what the assessment tool will be about. I'll give them, for example, the frequency of tests, the frequency of labs; I'll explain to them what I expect on each of those assessment tools. And usually, before each test, we'll do a run-through of some practice problems, some test-type questions, and I'll give them an idea what different sections of the test will have on it.
Our journey at this point illustrates that Bob was still struggling with his current assessment praxes. Bob believed that he needed to use more exemplars. Contemporary assessment literature suggests that exemplars are used to illustrate what the process or product should look like, thus providing tangible guidance for students on what to expect, and how to prepare them. (Wilson, 1996) Earl and Cousins (1995) remind us: "Tell me -- I forget; Show me -- I remember; Involve me -- I understand!" (p. 32). From our discussions, Bob believed he could do a better job of assessing if he used more exemplars of questions, projects, and performances, and he was working on putting these in place throughout the study. Bob provided further information about what he was assessing when I asked:

Do you group your students according to ability?
Bob - No, they are already streamed when they come in, based on the class. When they come in; there's no grouping beyond that?
T.R. - You assess largely knowledge, and not social skills.
Bob - That would be correct.
(October 8th, 1997, p. 4-5, one-to-one interview)

Bob targeted knowledge constructs in his traditional praxes, yet he knew this may have to change as the new curriculum arrived in the 1999-2000 school year. I asked Bob about different targets and why he concentrated on the lower levels of the cognitive domain in his assessments.

T.R. What Higher Order Thinking Skills (HOTS) do you target? For instance, do you ask students to compare, contrast or judge? Are we only dealing with lower level recall of knowledge in these exams?
Bob - I think that in any section you would find different levels of questions. (January 7, 1998 p.2)

Bob tried to stretch his assessments to cover more targets. However, he did not use any other means of evaluating his assessment tools. He worked alone. Often there wasn't time, nor a network of people set up to do so. As well, Bob stated that he had tried self and peer-assessment but it didn't work. Bob then shared his science department guidelines, which are adapted to individual courses as necessary. The examples illustrate assessment and evaluation policy and praxes as these are applied to specific courses (Appendix N). Bob added:

In my physics course most of it would be knowledge-based assessment. They do a paper during the semester, so I'd be marking them on their writing, written presentation, and they would also have the option of doing an oral presentation. They would, actually, give a seminar to the class about their paper. I'd be marking their oral expression. They have one group assignment during the semester where they are asked to run the grade 9 science Olympics. (Appendix L) They are actually running the events. I'd be marking group skills and social skills. The vast majority is knowledge-based assessment. (October 8th, 1997, one-to-one interview, p. 3)

This excerpt demonstrates opportunities to target other domains, such as the affective and psychomotor. In doing so, assessment becomes more holistic, which enhances essential credibility and legitimacy.

7.4 Assessment Needs

In this section, I address the research question that asks: 'To what extent did these initial understandings and actual practices change due to the illumination of
assessment praxes? In doing so, I detail Bob’s assessment work both in the classroom and in theory. As well, the remaining sub-sections shed light on the extent and breadth of several changes Bob made in theory and practice. Bob had gained a new perspective and understanding of assessment and of the needs of participants to theorise and critically reflect on their roles as teachers, guides, coaches and facilitators. Bob saw the usefulness of support and encouragement in a group situation. He wrote:

Each time we met as a group I got the impression that we became more productive as people brought reflections to the table more easily than they had before. It was easier to challenge views since we were all interested in improving assessment. I now see that my assessment was less than contemporary but that was a consequence of my situation and not deliberate. The group is working well. Cal has really become a contributor, Jan is also and Pat is still struggling I think because of the adjustment that is required during the first year. (March 18th, p. 31)

He also realised more thoroughly the extent to which some participants were opposed to certain policy and practice. The opportunity to critically question each other was exciting especially given our common goal to improve. For instance, the thought of students conducting self and peer-assessments seemed to contribute to turbulence during group reflections. Bob used these moments to move our group forward in order to change and promote growth for all participants. By our fifth month of discussion, Bob was requesting a working meeting. He was specifically concerned with his lack of assessment development, his departmental assessment needs and the assessment needs of students. Bob sensed that our group had reached a threshold for theorising (reflection) and now wanted to apply these notions. For example, as illustrated in the January 22nd, 1998, group meeting.
Yes, I'd like to go in that [peer assessment] direction. Yet it seems to have some real logistical problems if the kids we talked about are in grade 12 or OAC, and haven't seen very much peer or self-assessment. What I noticed in my class is that the kids do not come to consensus well. I understand what you mean about maturity level, and I know it's HOTS and that's what makes it difficult. Trying to get them to a higher order of thinking. They don't have the skills or tools to do that, and it's tough if we are not all doing that.

T.R. - So, what makes this February 5th meeting significant is the intention to produce an assessment tool for the department to use?

Bob - I would think, yes. I mean a couple of years ago, when we tried to do it in the grade 9 program, I guess we were hoping to build on that for the department. And then, when that didn't work out, we had the self-evaluation checklist. That didn't work out, so it was very difficult to expand into the different grades. (p. 2)

Much of the difficulty Bob spoke about came from the lack of a support network. He vowed to change this by continuing to work in an action research mode beyond the conclusion of this study. Bob would attempt to do this in spite of government funding cutbacks, which would create a higher pupil-teacher ratio and cause further reductions in preparation time. He knew that to change assessment praxes and implement some alternative assessment tools seemed to require more preparation time, and support from peers and administration. In spite of this, and owing to Bob's appreciation for action research and its underlying communicative rewards, he planned to meet more often and not less. He also realised how his assessment praxes are a direct consequence of this lack of time to develop his assessment literacy and assessment tools. Bob had little time to critically reflect on fundamental questions of assessment or his praxes, yet this study created a window, which propelled him onto other questions concerning the way it was in education. On March 4th (1998), Bob remarked:
Sometimes it's not until 8 o'clock at night that I have a chance to reflect on the day.

T.R. - Jan was saying that due to time limitations she doesn't do a lot of the things she could. Also we don't really know what is going on in other people's classes.

Bob - Right - No time to collaborate and the staff meetings are more global administrivia tasks and policy updates, etc. (p. 2)

We then addressed the myth in education that a 'good' educator encounters few problems and discussed why most teachers move towards the preservation of this myth (Hargreaves & Fullan, 1998). Our inquiry caused participants to stare down this myth at every act of reflection, action and revision in order to realise the potential of action research as a mode of communication, theorisation and collegiality.

By our last group meeting Bob was looking at the possibilities. He realised that change in theory was easier than changes in his practice. To change his practice he would have to be selective. Proceeding in this way would ensure that the changes made would meet the needs, and not create more needs. On April 9th, 1998 I suggested:

So you have 6 years experience now, magnify that by 3 what are you feeling now?

Bob - That's where you begin to resist change. It's a problem. I think we can take the good stuff out of what is about to happen and say, ya, I can see how that's good stuff, and maybe we should be doing portfolios, more self and peer-assessment. Maybe from that perspective we can take on that stuff but we are experienced enough to look at all that stuff with the bad stuff coming down and say let's not do that. We don't have to do that and I think with transition years we thought we had to do it all and especially as a school we embraced transition years whether we thought it was good or bad. We did it all and it tore the staff apart, whereas now we are looking at it and saying this is good let's go with that and I think professionally it's much better. (p. 4)
Bob has been able to reflect upon past efforts and distil certain facts. He now has a plan as the next change effort approaches. Bob's plan is now supported by participants who have also developed practical approaches. It is common in action research for each member of a study to have individual plans (as well as a group plan).

7.5 Tensions

Bob's role was multi-layered and diverse. During a typical day, he would have a period in which he acted as a guidance counsellor, then two periods of science, a period for preparation/administration as Department head, and coach extra-curricular sports (Basketball). During the 1997-1998 school year Bob also participated in this study, which meant voluntary obligations to attend one-to-one interviews, group meetings, and develop a journal. Bob was spread thin, he was stretched, and the strain was at times noticeable. The following provides more details concerning changes Bob made in his practice and some of his personal theory that supported these classroom practices.

On April 1st, 1998, after enduring the two-week strike in November and nearing completion of both this study and the second term, Bob was quite concerned about his responsibilities as he explained:

I was talking about this science advisory workshop and the Board sees the position as a curriculum leadership and I would be very happy with that and we would have meetings and talk about best practices, etc.
The reality is that the job involves keeping the labs clean, putting things away, safety inventory of chemicals et. cetra. The Board doesn't want to address the fact that this job has that reality. So that's disappointing, and it's hard to move forward to improve your curriculum delivery when you are bogged down with other tasks. It's also very labour intensive if you wanted to do it right and ah — you don't have the time and you are not seen as a priority with the Board in terms of time. (p. 1)

The tension in this excerpt was directed towards the Board and the seemingly unending tasks that can be added to one's role. What makes this strain even more alarming is that no one is monitoring how much a teacher does, except the teacher. I could sense the stress in Bob's voice and I suggested he cut back and do only those things he enjoyed most. He agreed that he needed to say 'no' more often. Yet this was stressful for him because he would have to make changes, some good and some not, hence his concern. We continued to reflect April 11th, 1998, as I stated:

All participants have at some point in our discussions used time as a reason for not doing something — Why?
Bob - It's the nature of this job. You're not going to be able to do it perfectly and you have to settle for the best that you can do. Bringing new assessment techniques into the classroom takes time and energy as you struggle to succeed. When you get bogged down in other people's priorities, it can really wear you down. (p. 1)

I believe Bob was letting me know that even though he was trying, at times, he found his collective responsibilities too demanding. So, he could only do what was possible, in that limited amount of time. There was tension during our project. Bob suggested: "This [study] would have been better in any other year. Due to the strike I don't have the same outlook as I usually do" (February 18th, 1998, p. 4). Yet, throughout our study, Bob showed few outward signs of tension, to me at least, and
there was little in his journal that would suggest anything to the contrary. However,

April 11th, 1998, was a day of venting for Bob, as I asked:

Are teachers always in conflict because of the demands of administrators and the demands on the teacher? Is the system adversarial and oppressive?
Bob - Well with my OAC's right now I've missed so much time going to safety meetings, curriculum council meetings concerning administrivia. So my class and I have agreed I can not go to any more meetings—their needs are a priority, no matter what happens I am first a classroom teacher and everything else second. And the Board looses sight of that because their needs and priorities are put first. There is a real contradiction there because it has really affected teachers and their amount of time out of the classroom and, in turn, this has really affected the student's learning. (p. 1)

The tension, between the Board, students and teachers was strong, leaving me with the sense that teachers were frustrated with the lack of attention given to their situations and timetables. This state of tension leads teachers to certain realisations, as Bob explained:

We are the tools of their political doing. I mean they have an agenda and we are the tools to help them get there -- it's constant downloading and we are doing a lot of things that will never affect the kids and their learning -- it's given a priority because the Board sees it as a priority for them. (April 11th, 1998, p 1)

Bob felt that many of the Board's assigned tasks were not directed towards learning in the classroom. Hence he questioned the Board's actions and these reflections led to resentment. I theorised that Bob probably ignored some of the materials the Board sent to him as an act of passive aggression. This could be why he was not aware of current Board assessment directives. Yet, Bob assured me that, "I put the students
first and if I'm told to do something the first thing I ask is, will it help the students?"

T.R. - Is the Principal here enough?
Bob - I've never seen a Principal asked by the Board to be somewhere else so often. My opinion is that she has been out of the school far too often—2 days a week minimal. Our small school has really been affected. (April 11th, 1998, p 1)

Bob was now showing a side I hadn't seen all year. It was a hostile portrait, in which a school leader was painted black. I saw a parallel, in that Bob was away at the request of the Board and so was the Principal. If we were to fix blame maybe we could shift it onto the Board, who seemed unaware of the emotional cost of missing leaders. This does not help us resolve the conflict; to resolve it Bob will have to make it known. Fullan (1997) adds: "It is when conflict is mishandled or avoided that it becomes most destructive" (p. 33) For Bob, I believe he now realised the value of direct communications rather than just emotional reaction. We then moved on to other issues while Bob plotted his strategy. Bob noted in his journal.

What I find amazing is that even though you think you do a good job communicating, it isn't until you face one-another that you really begin to understand the whole message — Our group discussions have allowed me to move much closer to people's visions of assessment. It is worth the effort meeting, even though other things are sacrificed, to do this. (December 11th, 1997, p. 11)

During our one-to-one interviews Bob was professional, thoughtful and supportive of our project and all participants. We did not come into conflict with one-another personally or professionally. We usually agreed that there was a lack of time and a need for efficiency. These two factors really were the cause of Bob's current
assessment praxes. It seemed as though we had similar attitudes towards most issues in education. Therefore, we located a great deal of agreement, yet later, in Chapter 11, a few tensions are described.

### 7.6 Assessment Praxes: Resistance to Change/Obstacles

For many practitioners it is not enough to simply develop theories about assessment. Practitioners often want to change the situation immediately, to make it more current and effective. At the same time, they want to improve their knowledge and skills. To do this they must overcome several obstacles, which seemed to appear as we attempted to develop action strategies and make changes. Our project had a specific starting point and many distinctive action research ‘moments’, yet our work did not seem to have an end point. Indeed, “some people say that research is a ‘never-ending task . . . . Action research, however . . . . will finish for pragmatic reasons, even if some questions are unanswered and need further investigation “ (Altrichter, et. al, 1993, p.155). We felt, at the conclusion of this project, as if there was still a lot of work to do.

The following represents attempts to further address the research question: ‘to what extent did these initial understandings and actual practices change due to the illumination of assessment praxes?’

For Bob, one of the problems was that of ‘change’ during a busy term. He wanted to move both himself and his department away from assessment praxes that represented a previous concentration on content-based programming. At the onset of
our study he used a textbook and fixed time units (semester, terms) in order to supply a grade. He tended to repeat courses by using reference binders he had inherited. However, since the possibilities for assessment had increased due to our work together, he now wanted to implement new assessment knowledge, modes and tools. He wanted to help himself, his department and his students. Still, many obstacles remained, as he required funding, time, and guidance to locate, develop and implement these assessment tools. Bob wrote:

To meet the expectations of the Board [Appendix E] all teachers need to learn these new assessment methods and practice using them before we bring them into the classroom. I have little time in a day to go off and prepare some new assessment if students expect their tests back the next day or grades have to be in or I have to coach a tournament. We need to bring in supply teachers so that we can be released to take care of business, the end. (January 20th, 1998, p. 22)

Clearly, Bob wanted to be involved in sound professional development activities focused on contemporary assessment (practice). Hence his involvement with this study. But, faced with current obstacles, Bob believed much of the opportunity had been squeezed out of his agenda. What professional development the Board supplied was deemed wanting, as noted earlier. So, how could he achieve these outcomes while facing these obstacles?

For this year anyway, assessment was viewed as it always has been as something done by the teacher (content-based program). It was subject-based and not outcome-based. The learner was encouraged to acquire a fixed body of knowledge transmitted under the control of the teacher rather than learning the skills of communication, reasoning, and problem solving (Griffin, 1998). Bob's current content-
based program still was an acceptable tradition, due to his rational authority (Peters, 1966). Moreover, students expected this type of assessment. Also, it was within his 'sphere' of expected competence. Bob implied this, and at times, made it quite explicit that he assessed in a manner that his own teachers had, as noted earlier in the chapter (7.2).

Our goal was always to improve and rather than unfairly criticise Bob. We acknowledged that he was doing what he could, given the ever-increasing demands placed on his time and abilities. Still, Bob had become like so many other teachers who assess in a teacher-centred, content-based manner: he had given up his ideals in favour of traditional practices because of limitations of time, isolation and opportunity for professional development (Rosaen & Schram, 1997, p. 257).

As our study matured, Bob realised just how many questions he had. He was realising that assessment was not subject specific; rather, it was a general means to gather data that was equally challenging in all subjects. Bob had recognised that he could use many of the insights discussed and apply them to solve many of his assessment problems. He planned to change 'how' he assessed. He wanted to become more student-centred and varied in his approach, and thereby empower students. To do this he would have to change from a routine of planning, teaching and assessment to an assessment, planning and learning routine. He wanted to nurture more student input, and so, when I saw evidence in his classes of a shift, I asked Bob,
Why the movement towards self and peer-assessment in this second term, when, in the first term, you omitted such an assessment tool from your assessment plans?

Bob - I think it does a number of things in this particular part of our course. The kids are doing seminars and there are some things I need to do to ensure that they are attentive during the seminars. The students will do a good job during their seminars. Sometimes giving them marks is not enough, and if they know that peers are assessing them the pride element may motivate them to do well. And the people who are doing the assessing are going to be very attentive when they are listening to the seminars. They are going to have to really think.

T.R. So, how much change has this assessment been from the one you used last term?

Bob - I think it's a change. It's one new tool for peer and self-assessment. So I'm not eliminating previous tools, I'm adding onto the number of tools I have. I think I need to feel my way out and learn how to do this so that it will be successful.

(February 4th, 1998, p. 3)

This movement along a path was a result of five months of reflective discussion, planning and group work. As Bob moved through this study, as a group member, he came to see his transformation as a response to the needs of students rather than a response to an external agency mandate (Board or Ministry of Education). Bob noted "if I wait for someone to do it for me it will not get done. I have to make it happen, as I have learned how to lead, to take risks and stick my neck out" (Journal, March 23rd, 1998, p. 40). He also viewed the development of assessment tools as a means to prepare himself and curricula, which would have direct benefits for his students and his Department. I continued to support Bob, to probe and apply pressure, by asking:

What are you doing by teaching your students how to assess?

Bob - I think you are giving them the responsibility and the onus is on them to decide what is valid and what is not. They decide what is important in the course. They are the ones that have to decide what's important. It requires higher order thinking skills on their part to make some decisions.
T.R. How would this impact on students' perspectives?
Bob - I see myself as moving in a direction, along a path. I think what we talked about another time, where these kids are OAC students and they have gone through the system for 12 years. They have had little or no control over their assessment. To tell them they have all control may be too much at once and it may say that their marks are not going to be valid because they have been biased by their previous experiences. (February 4th, 1998, p. 4)

In principle, Bob seemed to support collaborative assessment modes. However, in practice he saw many obstacles that dictated a deferral until next year. For example, Bob suggested each student's ability to assess themselves was diminished, due to a lack of opportunity, previously, in science classrooms. I wondered if Bob really was sincere in our discussions concerning assessment change. Yet, while in class one day, I observed Bob taking those first steps to include students in the assessment process. He was moving from a role as transmitter to a role of facilitator, I thought. It was messy, and I wrote in my journal:

Bob tried to organise the class into discussion groups and some of the groups did supply a final product. A few students seemed unable to offer any insight into the development of a peer-assessment tool. They listed criteria of a good student, which seemed to be quite reasonable. 1. Be on time for class, 2. Have all your materials, 3. Finish homework, 4. Pay attention, 5. Help each other. I thought that this would be helpful but Bob seemed to want to move the class onto the next unit because it was more important. He said he would come back to it next term. September 1999. It's frustrating watching him try this. I really feel as though I need to step up and show him but I may undermine him and I don't want to imply anything negative. (March 4th, 1998, p 41)

At the time I believed the actions of Bob would free the curriculum in order to focus on key outcomes for students. Yet, it was a problematic experience as the movement away from a content-based program is quite difficult due to many impinging variables
such as timetables and administrative demands. For example, the requirement to produce marks. By the end of the study I was hopeful, and Bob assured me, he would continue along our path while searching for more enlightening assessment outcomes. Bob did believe in a varied and alternative means to assess and showed me an observation checklist for lab cleanup that he had developed with students that would be used in other classes by all science staff (Appendix M). I hypothesised that more change would be slow and could be easily derailed once our study ended. I hoped I was wrong.

**Perspective Transformation**

Bob did maintain his commitment to the present structure but he made plans and small preliminary movements toward new practices. So, our transformation refers to alterations of Bob’s theory and praxis. The process of reflecting and developing strategies for change was at times quite verbal, as the evidence would suggest. The other aspect of communication, the non-verbal side, for the most part goes unreported. My job was to get Bob to talk about what was tacit and unnamed. Other non-verbal evidence came from my classroom observations and assessment tools I collected (Appendix M). As well, the extent to which assessment drives the curriculum becomes clearer as Bob and I reflected on past, present and future assessment procedures. We discussed the view that contemporary assessment is not just a means to identify content knowledge, rather it drives the very plan for a curriculum, especially in outcome-based programs. We realised that if we didn't improve assessment procedures we would not improve curriculum for ourselves, the students
or the Department. Moreover, it has been suggested that:

Until assessment and evaluation are seen to be classroom oriented, active processes of making judgements that involve all the participants, and that are integral parts of the curricular process, it is doubtful whether change can or will occur in our schools. Ultimately, what is taught in the classroom will be determined by the assessment and evaluation programs used, and if changes are to be made in educational practices, evaluation procedures must also change. (Anthony et al. 1991, p. 21 - 22)

As we discussed this passage, we reviewed similar calls for the reform of assessment praxes that are increasingly widespread and increasingly insistent. For instance, Earl and Cousins (1995) have characterised assessment changes as “changing the face - facing the change”. And Stiggins (1994) has suggested that we have moved from sorting and selecting to searching for competency via assessment. Further, Hargreaves and Fullan (1998) have urged teachers to become "assessment literate" (p. 98), in order to defend education and conquer their own fears. The notion of literacy involves understanding theory and practice in a manner understood by colleagues in order to put forward credible judgements consistently (Fullan, 1998).

Throughout this inquiry, Bob experienced moments of sudden realisation. He realised he was somewhat isolated, because he was the only physics teacher on staff. He realised he needed more information concerning assessment, as this extract illustrates:

I do not like the fact that I am unaware of the reports the Ministry of Education is publishing. I don't really have time to search these out. It was amazing to find out from Tom that I could do this quickly by using the Internet. After looking at some other Board pamphlets Tom gave us I can see just how far behind our Board is. (February 10th, 1998, p. 25)
These realisations moved Bob to question what he was doing in class and in our study. He addressed his roles as participant, teacher and Department head both directly and indirectly. He spoke about his need to change and refashion his assessment praxes several times throughout our journey. For instance, in the latter stages of our inquiry Bob stated:

I think to a certain extent I have changed. They have lab tests where they take the equipment out and use it. The independent studies now have to be a research paper on a topic that they choose. The method of presentation, such as an exhibition or paper was theirs. T.R. Are you going to do more of that in the future or is it too difficult? Bob - It's always easier to stay the same. What's going to motivate me to change is the sense of reward I get from changing. If you're stagnant you're not going to find it as nearly rewarding as if you drive yourself to improve by changing. (January 7th, 1998, p. 2)

On January 14th, 1998, four months into our study, Bob explained that he would ask the students how they would like to be assessed. During one of my many classroom visits he worked on constructing an assessment with the class. It was a first step towards a more student-centred means of assessment. I use the term student-centred to indicate that inclusion was valued. A role was given to students in order for them to contribute and partially develop the assessment. I made several observations on this occasion, for instance:

The mood in the class has gone from one of passivity to one of celebration (students are more talkative-social). Bob seems a little unsure about what to do next. I want to move forward from my sitting position in the class to urge him on but I think I should just let him make the next few moves. Some students seem to be objecting to any changes. Other students seem eager to help. Bob needs to organise the tasks but he doesn't have enough time today. Bob stands behind
the science counter at the front of the room clearly concerned about the new level of activity both verbally and non-verbally in his class. I think students are feeling and showing signs of stress due to upcoming exams at the end of January. Any talk of changing an assessment now is doomed I think. Just bad timing. (Journal - January 14, 1998, p. 63)

During a follow-up discussion on another day, the students said they enjoyed the task and many said they had felt empowered. Nonetheless, there were some students who wanted more of the same traditional teacher-constructed assessments. I saw this as an issue relating to predictability and trust, in that they could predict and study for something they knew so well, past assessment modes. I observed the class work through several questions, such as 'What should be on the test (content)?' 'How should the assessment be conducted (form/method)?' 'How should the interpretation of answers (weighting and numbers) be done?' The class was dealing with fundamental issues concerning assessment. What to assess was the centre of the discussion. A lab, knowledge and social skills were three aspects discussed. Yet the discussion brought to light many other points of debate concerning each assessment method and its marking scheme, and it was clear that the depth and breadth of the discussion would not fit into one tailored High School 'period/class' of 76 minutes. Hence, what began with promise ended with the sound of the bell. We just didn't have enough time. Further, the curriculum plan dictated that the issues would be left unresolved because of the need to ensure textbook coverage, which was a priority in Bob's view.

Still, a number of points mentioned during this discussion were worthy of further examination. For instance, the notion that equipment was actually 'taken out'
appeared to be a significant event for Bob yet, this was for infrequent labs and further illustrated his reliance on theory (textbook) and not on applied tasks (practice).

Another intriguing fact appeared, students had only a choice of topic and method and not an opportunity to assess or take part in the development of the assessment. There was still work to do to move away from the teacher-centred assessment. Bob's reaction to new views of assessment, and the notion that 'good assessment is good teaching', was conservative. The many obstacles he saw in his path slowed Bob's progress. As we worked towards our targets of comprehensive assessment praxes that empower students, Bob had more questions and uncertainty. In fact, there were many reasons and forces that contribute to the stagnation (status quo) in education. It is a cyclical process in which you always seem to return to your original position. What is comforting is that groups of teachers can overcome this inertia. By joining together, educators can become empowered, less isolated, less individualistic and less static. They can move forward with focused purpose. Teachers need to realise that peers and students can help them be less individualistic.

T.R. - What was the impetus for this movement towards peer and self-assessment?
Bob - I think, to a certain degree, our discussions about assessment and about the validity of assessment. I think when I look at the class and talking to the class, I think that this is something they are interested in doing.
T.R. Did the expert panel synthesis in any way provide an impetus for taking the direction you are now?
Bob - No. I really haven't had a chance to look at that closely, so I think it's based on our discussions.
(February 4th, 1998, p. 2)

Bob continues his examination of his assessment praxes; he is building his trust with
students, taking risks, and learning to assess with fewer teacher-centred paper and pencil tests. He is doing this because he knows the award of a traditional grade is no guarantee that something has been learned (Smith, 1988). By taking steps to prepare for classroom assessment challenges, administrative demands and government meddling, Bob can fortify his enthusiasm, learn, and motivate himself and others just in time for the beginning of the 1998-1999 school year. Bob added:

Bob - We are going to take a look at that next year, for the grade 9's T.R. Apparently, there are some schools where they have done away with exams in favour of long term alternative assessments. It's not my idea to change assessment but, it is a collective assortment of reformers who are asking people to critically examine what they are doing. Bob - I guess, initially, people are going to perceive it's your idea because it's something different from what they are doing. But, once they see it is in the expert science panel reports, people are going to change their mind. (April 1st, 1998, p. 2)

Bob was telling me in a nice way that just because we had completed this action research effort it doesn't mean his employer and government requirements will go unnoticed. Quite the contrary, he would continue to follow their lead. Bob continued to explain how he'd approach science journals next year as a tool for assessment:

Bob - I guess you could change it around and call it what you want. In their lab report, basically, there is stuff I don't mark at all. I find frequently I can mark labs very quickly without marking it all. Normally, within their conclusions and their sources of error, it is sort of a journal of sorts; I guess we just don't call it that. Because what they are doing in their conclusion, they are telling me about the experiment, what they learned from it, and some of the things that may have gone wrong along the way that effected their results. It's a very concrete way for them to tell me exactly what they experienced, and some of the ways they might improve it if they were to do it again. (April 1st, 1998, p. 2)

I was encouraged to hear of his plans since he could have just thrown up several
excuses why he couldn't do anything to change. Bob continued to unveil his plans.

T.R. The use of exemplars in your lab, was that done?
Bob - Some of the labs I do. Some of them I have them open-ended because I think in some instances it is important to do an investigation where they do it from their own ideas rather than being too prescriptive. I don't want to limit their creativity in terms of how they do the lab. If they see it, set up, they do it identically. Sometimes they are getting too much information.

T.R. The beauty of an exemplar is that it provides expectations non-verbally and verbally. Do we depend too much on the verbal channel?
Bob - I am not quite sure, ya I'd agree with that. I think when it's something new, like right now, I'm working on exemplars for the presentations that they are going to have next year. I can put myself in their shoes and you can more easily guide them because you have done the exemplar and know some of the challenges more intimately.

(April 1st, 1998, p. 3)

Bob is well on his way to modifying his assessment praxes. He made many changes in attitude and opinion, and pointed out that his beliefs have become stronger in the area of assessment due to our discussions and work together. Bob wrote:

I can see myself being a little less in the middle of each assessment. I would like to try more self and peer-assessment and have science journals. I hope to have more labs and lab tests where they apply some of this theory. (April 17th, 1998, p 49)

What he requires now, is those two months during the summer to prepare, as is the case with most teachers. While away from the buzz of the classroom and schoolhouse Bob will have more time to reflect. However, this refreshing break might also be a time of further individualism and isolation, since it is unlikely that Bob will work with other teachers during this two-month break.
Chapter 8

Jan: Past and Present

Introduction

This chapter illuminates Jan's assessment practices by reporting elements concerning several contexts: preservice influences, inservice assessment aims and rationales, current assessment praxes (methods), assessment targets, assessment autocracy, obstacles to change and so on. Our relationship evolved over an entire school year and I got to know Jan as a teacher, a participant, and finally as a colleague. Over time, these roles grew more familiar to me, yet they were quite distinctive and intertwined. I became aware of her assessment transformation on three levels: professionally in the classroom, collegially in our study group and privately during our one-to-one meetings. At each level there were changes in theory and practice. Indeed, Jan made several obvious changes in her assessment praxes over time in spite of obstacles, as noted in the chapter.

8.1 Assessment: Preservice Influences

At each group and one-to-one meeting Jan was very much enthused. She usually greeted people with a smile and her comments were often positive and hopeful. Typically we met in her science classroom and placed the tape-recorder on the lab workbench in order to capture our conversation. Jan would start by discussing whatever was on her mind, yet she was keenly aware of our assessment focus so she
usually spoke about related matters. Jan wrote:

Each time we meet to discuss assessment I feel as though I have a chance to move ahead and for this I am grateful. It is hard some days to stay on topic because there are a lot of other things that bug me every day. I know we need a focus but this experience has made me realise my need to discuss things with others more often. The benefit is that you don’t store up your thoughts you vent them and this is something I like to do - vent. (November 19th, 1997, p. 21)

During one of our one-to-one interviews we sat in her now quite empty classroom surrounded by typical science artefacts. The periodic table hung on the wall, an overhead projector on a black laboratory worktable stood ready and shiny gas outlets sat idle. I moved about on the hard green science stools just as I did many years ago as a student. Jan reflected: "I approach my job positively." (October 8th, 1998). The positive side of Jan was quickly apparent in her strong advocacy of science and her hopeful views about the future of her students. She wrote early on in her journal:

I have always been good in math and love to be outdoors; this led me into the sciences. I was a minority in my University classes but this was a good thing and not something to worry about. When I did well I was refreshed and this motivated me to go on in science and sports too. I love to play and coach sports especially soccer. I try to bring this attitude to my classroom. (October 12th, p. 5, 1998)

Each meeting in her classroom (science laboratory) was something I looked forward to. I believe I looked forward to our meetings because Jan was excited about not only our study but science also. We discussed Jan's early assessment experiences.

T.R. Tell me about your past: Did you have any training in assessment? Jan - No formal training, no. At St.Francis Xavier University, I took courses for the B.Ed. in Antigonish. Science and math background, but my teachables are chemistry and general science. My undergrad is
chemistry, B.Sc. They assessed us by labs and problems, predominately, defining terms.
T.R. Any authentic problems connected to the real world?
Jan - No, it's not really until you finish your undergrad, then you go out and apply it. Until then it is abstract, basic knowledge.
T.R. So you had the theory and not the practice.
(February 4th, 1998, p. 3)

Obviously, without specific training in assessment, a teacher is more likely to continue to use the practices already in existence at a school or practices they were exposed to while a student, rather than impose a scheme that is new to the school or themselves. For instance, during this exchange, I pointed out how Jan assesses as she was assessed.

T.R. You mentioned previously that you model your assessment practices based on former colleagues.
Jan - Susan (former teacher), yes.
T.R. So that leads me to suggest that maybe you assess the same way you were assessed when you were in high school.
Jan - Yes, I think fairly similarly.
T.R. So then maybe your teacher in high school assessed the way he or she was assessed when they were a student.
Jan - The trend is continuing.
T.R. Do you think that is good?
Jan - It sort of gives me the feeling that maybe we are not allowing for much room for growth there.
T.R. Are we moving forward or are we just staying the same?
Jan - I don't know. (October 8th, 1997, p. 6)

I believed that this portion of our interview allowed me to infer the kind of assessment praxes Jan incorporated into her teaching. Her assessment praxes were content-based (traditional). This meant that she was subject matter based, used fixed time units (unit, semester, and term) and acted as the transmitter of specific information. Assessments usually produced delayed feedback, and were created using narrow
references (textbook, lab manual). Jan followed a system that realised a final percentage or grade as an outcome, and the learner would follow a predetermined course of learning. Teaching plans were developed to deliver a body of knowledge and follow a consistent planning, teaching, assessment order. Although Jan had not yet moved into an outcome based (expectations) mode of teaching, she was quite receptive to change, growth, and reflection. Jan wrote:

For me to be in this study is a big step. I have not been taking risks and my work has been mostly hidden within the classroom. I did have two in-class evaluations when I started teaching but this was only to see if I was doing things as expected. Now I have a chance to challenge myself to move forward and by talking to others about assessment we will get better together. I don't remember doing this even at the Faculty. (October 22nd, p. 9, 1997)

When I read this in Jan's journal it made me realise just how helpful our study was. Even though I brought an agenda with me, our actions in general were viewed as a means to take us to a new level of performance that was better. Early on in our study I emphasised that one does not need be sick in order to get better. In other words, we need not judge the present too harshly in order to move onto better modes of assessment.

8.2 Assessment: Aims and Rationales

Assessment practice is rooted deeply in the beliefs, values and skills of each teacher and has to be teased out. I know that it has taken me a long time to sort out, critique and develop my own assessment praxes. Despite the strongly personal influence, assessment practice is also directed, to some extent, by the Ontario Ministry of
Education and Training. At this level, there were dated guidelines that Jan related to me. They indicated assessment weighting and made suggestions to assist teachers' assessment decisions (Appendix Q). In turn, local Board directives (Appendix E) supported them. At the department level, the Head of the science department and other science teachers made further assessment decisions that impacted upon assessment praxes. Teachers, within the science department, were ultimately on their own. There was no Ministry, Board or administrator visitation, usually, in any classroom, to assess the extent to which a teacher fulfilled guidelines.

Once again, I asked Jan why (function) she assessed.

I think I use it for motivation, feedback and progress made. I use assessment for all of those factors. In terms of motivation, at least what I have witnessed so far, in the last five years, is kids are typically motivated when they know a test is coming up. They flip out, they start getting their notes together, they run to the library, they get anything photocopied that they may have missed and they actually put an effort into, hopefully, coming out with a decent product. I use it as some sort of a reference point to see how they handle the unit. (October 8th, 1997, p. 5)

Using assessment to motivate, communicate and indicate achievement are functional and recognised uses of assessment. Naturally, different purposes for assessment imply different assessment methods. Farr and Trumbull (1997) add:

. . . Failure to give consideration to the different purposes for assessment, to the specific questions that need to be answered by use of an assessment, and to the wide variety of tools that are or could be available is justification enough for altering the entire philosophical approach to assessment and to the extant procedures commonly followed. (p. 206)
Each participant in our study suggested reasons for assessment. Indeed, the reasons and motives for assessment were part of each person's beliefs. So, it was my job as facilitator to enable participants to supply descriptive accounts of the situation by using questions that were probing, yet supportive (Stinger, 1996), in order to locate beliefs and values. In response to this probing, Jan replied:

I feel confident in the way that I assess. It seems like the students get a grasp of the concepts and they seem to be able to carry that to the next level. They don't see my methods as being – quote, unquote, – 'easy'. And they don't say that I am right out to lunch and I am much too difficult. It seems like it has found some sort of a happy medium, so I guess that enables me to have some confidence in it. But yes, I suppose I would have to speak to peers and see where they stood on it. Peers who have taught that particular subject. (October 8th, 1997, p. 6)

Until this time, Jan stated that she had not spoken with anyone on staff about assessment theory or practice. She did, however, talk to colleagues about many other issues. For instance, Jan suggested:

She called me on a Friday night – I think if you teach the same subject and same grade level then you tend to talk to each other more often than if you didn't. Right now Deb and I, we always discuss issues because we are doing very similar things but its not always this way. (March 5th, 1998, p. 3)

Many of the issues were related to student satisfaction. Therefore, I inferred that Jan was relying primarily on student satisfaction, opinion and performance in each course as a source of feedback. Classroom tensions were dealt with by asking questions of the students in order to resolve problems. On one assessment occasion, when I was visiting the class, two girls were passing notes, Jan asked, "Is that a note for me?", The girls looked at one another as if they had been caught in the act. Jan's action
seemed to resolve the problem. Later, Jan met briefly with the two offenders after class and listened to their positions. That same day, Jan admitted "one-to-one with a student isn't always possible due to time constraints and some of them need it" (March 5th, 1998, p. 5). Within our study group we had the luxury of one-to-one attention. So, as tensions (see 8.7) were recognised, we usually discussed and addressed these directly. As a result, our level of satisfaction was enhanced and we were able to openly reflect on issues that arose in our discussions. This provided a strong indication of the trust that had been developed in just a few weeks of inquiry.

Each time we met during our one-to-one discussions in Jan's science laboratory I sensed that we were more relaxed and open. The tape-recorder seemed less important and we listened to each other with more empathy. Jan wrote:

The meetings are stressful until we find out what each of us has to say and when we agree there is a feeling of support that we don't get to feel during a busy school day. From this supportive feeling I rain [sic] momentum to carry on. (November, 18th, 1997, p. 17)

Jan was noting the tension arising from peer interaction when the purpose is related to occupational growth and examination of beliefs, values and praxes. Teachers can be very emotional when it comes to teaching. In an interview situation it is suggested that interviewers "listen carefully for the emotional and moral side, that is, the feeling and the 'should' side of the responses. Remember that it is the teacher who is talking and you should try to listen . . . . " (Connelly & Clandinin, 1988, p. 53). Early in our study I began to listen carefully and this led to observations. Following October exchanges, I noted in my journal:
It appears as if this is the first time participants have discussed this aspect of assessment (competency). This is exciting and at the same time it bothers me that this discussion has not occurred more often as teachers' questions come to mind. I wonder if the teachers who taught me in high school would answer in the same way. It would be an interesting study. (October 1st, 1997, p. 5)

Because of my journal questions and our aide memoire, I continued to pursue assessment theory with Jan. In our October 15th, 1997, meeting I wanted to know what she thought of the workload and level of challenge for students. She replied:

I think you hit the nail on the head, when you said the grade 10's are really swamped. I've had parents say that the only work their kids have done is in science. But, they (students) said, "In grade 9, most of the subjects are not challenging enough." When they get into grade 10 all of their courses are challenging; they don't know how to deal with it. So, they do poorly on tests, because there's too much going on; they're just not used to it. (p. 2)

It struck us that not only were teachers too busy to look deeply into curriculum and assessment concerns, so were students. This breadth of content coverage seemed to challenge the grade 10's most. Grade 9 was a time of orientation and introduction, and grade 10 was a time for students to take responsibility for themselves, to work and achieve. Nonetheless, using a content-based program instead of an outcome-based one led to problems. These were largely due to preparation time constraints. For instance, often it was easier, and took less time, to address primarily lower order thinking skills via fill-ins, true and false and short answers on assessments (Appendix O). It was, and continues to be, a way of life in the secondary science curriculum, it seemed. When I asked if she just used the same binder containing resources and daily notes for each course in any given year, Jan lamented:
I found that with a couple of courses I've taught it [the binder] has served as a limitation — [prepared binder from previous year] I'm teaching a new course and to learn the content is difficult so I follow the plans I've inherited — and that's what impressed me with Pat this year as a first year teacher. She has the binder but she is just not getting through the stuff as I did — she is making a lot of changes, including computers, she's using some of the same labs but I found that she is kind of a breath of fresh air for this particular biology course and I think that's great for me to see. It might encourage me to do some things but there have been other courses where I have been limited by the binder I just kinda use it to get through the day and the semester. (April 9th, 1998, p. 4)

Jan gained strength from others in our study and offered support to all participants.

When Jan saw something she liked she was quick to support it and compliment the person or action. It was a trait that served her well and supported our action research throughout the year. Jan usually dealt with issues in a forthright manner. She didn't like to let issues linger. Yet all of us appreciated the truth that "in the privacy of the teacher's own classroom, it was too easy for the regularities of past practice to creep back and muzzle the innovation" (Rudduck, 1991, p. 26). With this in mind I move on to look at Jan's current assessment modes and awareness to see if there is a mismatch between her rhetoric and her practice.

8.3 Assessment: Current Pronouncements and Modes

Our previous discussion of current government pronouncements involved the examination of what the expert panel examining secondary science in Ontario has supported in the area of assessment as compared to the existing guidelines. (Appendix Q) I sensed that I had an unfair advantage. I was familiar with the newer document and Jan was not. So, I not only asked the question, I supplied some
specific detail. The detail would allow any teacher to answer in general. For instance, I suggested:

The report also recommends an STSE focus with practical hands-on assessments. What do you think?
Jan - Well there is still content that you have to get across to the kids. What happens if you do too many activities? I found their behaviour problematic. I think it's a matter of too much activity. It has to be 3 days activity and two days of lessons... (March 4th, 1998 p.1)

I understood this to mean that Jan saw a need to mix new outcomes-based and old content-based styles of assessment. Jan wanted to maintain the content-based program and yet she saw value in an outcome-based program where she was more a facilitator and not just a transmitter of knowledge. Again, she had not read the expert panel report because her Board had not released this to their teachers, at this point, even though it had been released by the Ministry of Education and Training eight months earlier. I had a copy. As well, Jan's knowledge of Board assessment directives was limited due to a lack of time to critically reflect on them. Jan believed that, with limited time, she could not put the guidelines into action properly. Time-after-time, Jan explained that she lacked the necessary time, professional development and support to do a good job of implementation. She noted:

While teaching I often get the feeling that there is too much expected of me. It leads to bouts of anxiousness but our work together this year has helped me cope better. I brought the issues to discuss with others. It has opened up communication and I like this team effort. (April 12th, 1998, p. 49)

I believed that within our study, questions were probing, yet global, and these questions were intended to clarify targets for reflective discussion. We often came
back to the same questions, as this benefits the spiral nature of action research, and this constantly challenged Jan's beliefs, values and skills (Earl & Cousins, 1995, p. 17). In doing so, we illuminated answers to research questions. We found out the extent of participants' initial understandings of assessment and ascertained actual practices at the onset of this research. For instance, Jan provided further insight into her understanding, beliefs and assessment practices when she suggested:

The way in which you assess the students will make you a good or bad teacher.
T.R. Well there's an axiom that states 'good assessment is good teaching'. Do you agree with that?
Jan - Good teaching? - I don't know if I would agree with that.
T.R. Could assessment be seen as judging?
Jan - Yes it is!
T.R. And could assessment be viewed as judging which relates to criticism?
Jan - Yes. (December, 3rd, 1997, p. 1)

Often, a simple question brought about a great deal of reflection and elaboration. For example, when I asked Jan how she arrived at a final grade, she replied:

I gave out guidelines at the beginning of the semester and on that it has divisions for labs, assignments, tests, exams and independent study.
T.R. And how do you reach a grade?
Jan - It's concrete for me. One thing I might do is boost a grade 3 percent: say 67 to a 70 percent, or a 47 to a 50, if they earned it.
T.R. What if the administration/office comes to you and asks you to pass a student?
Jan - It has happened.
T.R. Is it fair?
Jan - I don't think it's fair because the teacher knows the student and works with them for 4 to 5 months.
T.R. How do you feel when this happens?
Jan - It devalues your assessment and your professional judgement. (January 7th, 1998, p. 3).
Jan put a great deal of time, effort and energy into the design of her assessment activities, and to have her professional judgement questioned by an administrative policy was disheartening. Indeed, most teachers I have spoken to communicate this same sentiment. Yet, Jan had no assessment training and often felt uncertain. Because of this uncertainty, an administrative policy can easily override Jan's judgement, on the supposed grounds that "the grade is not what it should be." This is an interesting point to consider given the development of new assessment policies and practices in education which could reduce Jan's role to that of technician.

In her content-based program, Jan's test design prioritised the domain of knowledge, as evidenced by the frequency of words like 'what', 'who', 'list', 'describe', as well as 'outline' and 'state', on her tests (Appendix O). Often these directing words only required knowledge recall and limited levels of thinking (Midwood et al. 1994, p.201). Therefore, when her assessment praxes were discussed, what was immediately evident was the traditional approach and the narrowness of the assessment typical of content-based programs. This type of approach, which is common in content-based programs, made science seem like it was merely bits of information, facts and numbers which needed to be remembered. In the past Jan hadn't ventured away from the assessment modes of her predecessors — for many teachers, a common reality, given limited preparation periods and professional development. Jan had maintained a traditional means to assess that was efficient and produced the required numbers at both mid-term and end of semester points. So, any attempt to change this traditional assessment practice caused considerable concern, as the following
remark illustrates:

I've never done a peer evaluation in a lab. With this general level chemistry that I'm doing, it's the first time I've done the course before, so, I'm kind of in panic mode right now. I don't know really what the heck I'm doing. I know the chemistry, but I don't know how to teach the course right yet. I am trying to make it very hands-on so I'm not up at the front. Which means it's going to be a lot of work for me, in terms of preparation. I can't conduct my classes in terms of theory and content because these kids are just not going to relate to it, and it's not going to do them any good. I want them to walk away with some practical experience, so thirty percent out of the course — and I made this up solely on my own, is based on their lab work. What I plan to do is: I hope to give them time to do the lab write-up in class, because with general level kids, if you tell them to go home and do it, chances are they are not going to do it. If they attempt it, it will not be done completely. So, if I give them time in class, hopefully, they are going to do it well. They'll have my guidance in order to complete the lab write-up and, in addition to that, I want a chunk of that thirty-percent to be a peer evaluation. That way, it's not all me. They are having some value in that 30 percent. (February 4th, 1998, p.1)

No matter how much experience teachers have, teaching is intrinsically difficult and not something mastered in the early stages of a teacher's career (Hargreaves & Fullan, 1998). Jan was confronted with change and was attempting to assess (target) different areas. She had to move from a role where she was the transmitter of knowledge to one that caused her to facilitate learning via a variety of instructional techniques and groupings. She also was now in a learning mode that created many questions for her and her students. Her anxiety was typical of educators who move from content-based programs to outcome-based programs (Griffin, 1998).

Targets

As a teacher my assessments are designed with an ideal response in mind and from
this notion I develop learning opportunities for students. Knowing why you assess (function) is often related to an outcome, so I asked:

Is your assessment a means to instil class discipline?
Jan - I guess. But there has to be time for them to take notes, for instance I'm doing the Rutherford-Bohr model and I'm doing cations, anions, and talking about mass and atomic numbers.
T.R. Can you make it more concrete?
Jan - How? It's too abstract; it's something that is way out there. So tiny you can't see it.
T.R. Why cover it abstractly?
Jan - In order to discover how chemicals react you have to understand the basis of the protons, neutrons and electrons.
(March 4th, 1998 p. 2)

My task as facilitator was to stimulate reflection by questioning, acting and then reflecting on the context. Jan had logical and rational reasons for assessing the way (form) she did. Our discussions reaffirmed our assessment praxes and clarified issues. Our concern for too much content and a lack of depth led to this group exchange:

Pat - Ya, I try to use it. I always find the higher order thinking questions are the ones left blank or they get zero on, or say they didn't get this in class. They are less attempted - the grade 10's just block. That's why I didn't attempt that. But to get through some of the terms outlined by the Ministry you have to ask 'what' questions. And if you ask them they say they like the what, the when, the where questions, just the facts and get rid of the higher order thinking.
Jan - That's because it doesn't challenge them; it just allows them to rely on their rote memory. And that's why the kids are comfortable with it.
T.R. Yes, the path of least resistance is always going to be the lowest cognitive level of thinking. Such as what is your name?
Jan - That's challenging enough. (February 18th, 1998, p. 2)

Jan's frustration could be seen in this revealing remark about some students
and their seeming inability to exhibit even lower order thinking skills. I saw it differently. Some students, awash in curriculum content, become alienated. Hargreaves and Fullan (1997) suggest, "alienated adolescents do not make academically successful students . . . . You can't teach students if you can't reach them " (p. 30). The function of assessment can be redesigned to reach certain hard-to-reach students, hence my continued focus on assessment targets. For instance, I asked:

Do you assess equally in each of the domains, affective, cognitive?
Jan - It's mostly the cognitive domain.
Cal - Like when they work in labs 30 percent and their group work.
Bob - And then there is the grade 9 program where it's all teamwork and science Olympics where 100 percent is on social and teamwork type of endeavour.
Jan - So, they're with kids they haven't been with all semester, too. They have been split up in the grade 9 science classes so, that's an opportunity for them to work with kids they don't normally have an opportunity to work with. (October 1st, 1997, p. 3)

Our group had thought all domains were targeted, to some extent, in several contexts, such as the class, lab, Olympics (exhibitions) and individualised tasks. Yet upon critical examination, they discovered this was not so, and that they needed to improve domain coverage. By March 4th, 1998, we had completed many recursive discussions involving questions, suggestions, action (practice), and then reflection. This led me to raise further questions concerning assessment targets.

What are you attempting to measure in your self and peer assessments -- what are your targets?
Jan - I want the kids to value the labs rather than just following the procedure 1,2,3,4. I want them to take ownership of it. (p.1)
To do this required input from students. Our discussion continued when I asked:

What are you trying to measure?
Jan - We are trying to measure knowledge and the application of that knowledge, to try to find some connection, in the lab and what goes on around them.
T.R. How do you know what your targets are?
Jan - Mostly, I use the Ministry guidelines and a teacher's guide that goes along with the textbook. I also took a look at what they see as being the strengths. I get labs out of manuals and I look at what their emphasis is and I go from there. I don't come up with them myself; I get them from a written document.
T.R. But the Ministry guidelines are from the 1980's and the text is at least five years old, too. (Exploring Chemistry, 1992)
Jan - The text is 1994, and, I think it's Canadian.
T.R. Do they complement one-another?
Jan - Yes, they match nicely. The textbook is more activity based and involves technology more, more visual. (March 4th, 1998, p. 1)

Still, I saw Jan's reliance on what other people had done as a consequence of insufficient time to develop her own materials, not as a 'personal failing'. Her content-based program was not deemed 'poor'; rather, it was viewed as a consequence of increased content, a lack of support (isolation) and a lack professional development in key areas such as assessment.

8.4 Isolation and Time

Throughout our study Jan continued to deploy a largely traditional content-based assessment scheme that seemed to make students happy and produced the numbers necessary for the school administration (report cards). On several occasions she also made subtle changes to her practice yet she did this in isolation, an all too common situation, given most school timetables and facility designs. I noted the
following on one occasion when I visited her classroom (science laboratory).

Jan arrived late. Three minutes since the bell had rung. She had to take a phone call and this caused her delay. Her grade 9 general science students had settled into their stools (if that is possible) which lined either side of the laboratory workbenches. They waited for her arrival much the way an orchestra might wait for the conductor. They seemed to be under the control of the teacher rather than self-directed on this occasion. True enough, they were here and on time and they looked prepared but no one seemed to do any work. They were idle and chatting socially among themselves in this grade. Jan then gave out some ditto sheets talked about the content on the sheets mentioned the next quiz, returned a lab report and generally attended to administrative activities such as her record of student attendance and fielded questions concerning her lab assessment and evaluations. Students opened their textbooks and began to work on the photocopied sheets concerning science problems. 70 minutes later the bell rang and the students surged out of the classroom as Jan shouted several reminders to particular students and packed her things in order to move onto the next class. Even I felt rushed and I had no next class. (November 12, 1997, p. 38)

The pace of the period was at times slow, yet my thoughts and observations seemed to be racing. I wrote down my observations and I know some students must have thought I was doing something to meet a deadline, just by my high speed scribbling. I just saw so much that I wanted to capture. I wanted to record Jan's actions and the context and some of her interactions with students concerning assessment. It was difficult to observe and then record what I observed. I often was at a loss for the right word to describe what I saw. One thing is certain: High school teachers teaching three straight classes have an intense schedule, especially when they are in different grades. As well, it seemed that all the teachers in our study were somewhat isolated from one-another and from other departments in the school as they followed their timetables within the science department. It was hard for me to follow them. Often I
would have trouble locating someone. I had to go on a type of scavenger hunt looking for clues from various staff. Often their hiding spot was a conscious choice to get away to clear their heads. This seemed easy for them, due to the physical construction of the building. Like most High Schools isolation was easy to achieve since the staff moved around the building due to full timetables and a vast number of classrooms, offices and work rooms to occupy. Even the secretaries had a hard time locating people at times. With busy timetables that required staff to pick-up and move frequently teachers therefore had limited time for preparation. The science staff was not 'free' together to prepare anything unless they went very early before school or quite late after school. Insufficient time meant that Jan had little opportunity to think about or prepare new approaches, so she usually just did what was familiar. Jan also faced multiple demands and large class sizes each day and needed quick expedient means to address these needs.

The pressure Jan felt was due to insufficient time to prepare and this feeling was augmented by her assessment uncertainty and a year that had been shortened by a two-week strike. Even though our group was supportive, guiding, and resourceful, Jan’s enthusiasm often was not enough to overcome the obstacles it seemed. Her confidence did seem to grow, and she did discuss ways of doing new things, yet ‘time’ and other factors often stalled the process repeatedly. Both of us felt the frustration and would joke about it to relieve ourselves. I was glad to be helpful in this way because I knew that often, "assessment issues make teachers feel especially insecure" (Hargreaves and Fullan, 1998, p. 98). Nonetheless, I believed that
because of this study, Jan felt a need to change. She communicated this a few times.

For instance, she wrote:

I know that at some point things must change since I’ve been doing the same thing more or less for several years. I’m comfortable and this can be a problem. I ask myself why change until it’s necessary. Well, I like challenges and we can only talk about change for so long. Sooner or later I will do it. I’d like to start with some self and peer-assessment and build on this but I have to take baby steps. (January 23rd, 1998, p. 25)

I read this passage and linked it to Jan's need to decide freely, on the basis of our collaborative practical discourse, what course of action she should adopt in her attempt to change her assessment praxes (Carr & Kemmis, 1986). Our supportive discussions had brought about a commitment to try different methods of assessment, about which Jan had many questions. It was a big step to move away from some of her familiar assessment schemes, and she clearly needed support. Without it she was likely to retreat to these familiar ways and become cynical of the outcomes-based program which includes more criterion-referenced assessment.

Time limitations, and the perspective that alternative assessments were tacked-on tasks and not embedded in curriculum, led Jan to conclude that she could only incorporate a few of these modes of assessment at this time. Jan was attempting to use peer and self-assessment, yet it was approached as a tacked-on task rather than a way to reduce the extent of teacher controlled assessment. I noted in my journal:

I feel sometimes like I am a source of stress and not a source of support. The group does not suggest this in our discussions it is just a feeling I get when I see how hard these teachers are working now and here I am suggesting more needs to be done. (November 10th, 1997, p. 23)
Still, it was Jan who did not yet have confidence in student assessments. She was not eager to spend time teaching students to assess themselves but noted she would try. I think she offered to try because although she may have lacked confidence she did have some new self-knowledge that would be useful and empowering (Hopkins, 1993), as she moved forward. I also saw this as an outgrowth of our reflexive social interactions. Since, "social life is reflexive; that is, it has the capacity to change as our knowledge and thinking changes" (Carr & Kemmis, 1986, p. 43). Our focus had been developed to a point where Jan, as well as other participants, had gained more control over her professional life. Still, Jan saw coverage of the content as a priority, which is typical in content-based programs. Content had to be covered even though this year was shortened by a two-week strike. Time became a source of stress and tension for her.

8.5 Assessment Autocracy

Each time I visited with Jan I noted the extent (context) of her program. For instance Jan's content-based assessment practice meant she delivered a body of knowledge and assessed to measure the extent of student retention. Initially, there was an absence of student involvement and a degree of individualism (isolation) which meant Jan infrequently consulted with other teachers. This is not a criticism; rather, it is a feature of content-based programs. For instance:

T.R. Did the students have any input into the construction of the exam or contribute questions?
Jan - No. (January, 7th, 1998, p. 3)
Clearly, Jan's assessment practice relied on the content driven 1987 Ministry of Education guidelines. This meant that she depended on the content-based model that is quite narrow and emphasises the role of the teacher as the transmitter of specialised information (Griffin, 1998). This is in sharp contrast to the calls for more democracy and sharing in all facets of education (Hargreaves & Fullan, 1998). Jan was in a bind: She used many traditional means (content-based) to assess; had no formal assessment training or professional development opportunities to rectify this situation; and was not able to find extra preparation time to refashion her praxes, other than our project. It was fortunate that our study was, to some extent, addressing some of her needs. Jan wrote in her journal:

There are days when I feel really good about changing a test into something like a peer-assessment but to do this I need to first read up a little more on some of it’s good and bad points. I know there are several good books, it's just that I don't have these and need some help. Where's the help we say after a staff meeting. It gets cynical sometimes and I try not to listen to the cynics. (December 11th, 1997, p. 24)

Although Jan appeared to have a reasonably good understanding of how to collect assessment information, she was less aware of the significance of ownership in the design of instruments. Who develops the assessment can dictate the quantity and/or quality of the information collected. So, we began to investigate authorship of secondary assessment tools.

T.R. Why does ownership play such an important role in developing assessment tools?
Jan - I guess it would allow them to reflect the level where they are,
intellectually or academically. I think, if you let the class have input its going to influence the evaluation. (February 18th, 1998, p. 3)

As we continued to discuss praxes, we concerned ourselves with 'who' develops, designs, implements and, ultimately, validates the assessments. I asked:

So, while you assess, do you keep a lot of things to yourself? If so, is this a fair praxis?
Jan - I guess I was confused. I thought we were talking teacher to teacher, but now you're saying teacher to student.
T.R. - Does that matter if it's a teacher or student? Do you have two different standards for communication of assessment information?
Jan - No, but I try to think of the actual assessment I'm doing at that point in time where I do try to communicate that to the students. For instance, kids were doing an oral presentation for the OAC chemistry. I told them exactly what I was looking for. For tests, I do. I give them the criteria in most instances, but not always. (December 3rd, 1997, p.1)

It was interesting to note the priorities. For instance, Jan spent a great deal of time with face validity and content validity, yet criterion validity (standard aimed for) and construct validity (trait targeted and measured) (Farr & Trumbull, 1997) were given less attention. I then specifically addressed the issues related to assessment roles. I knew that both Jan and the students had roles to fulfil, which were largely related to a content-based approach.

T.R. - Would it be fairer if they (students) developed the criteria for assessment?
Jan - That's something we talked about earlier in the year. I would think that the students could. I don't do that right now and I don't think I would start until the new semester. I like to begin new things from day one. I like consistency. The students may see that as a weakness.
T.R. The term weakness hints at invalidity or soft data. If the assessment doesn't fit their expectations, then they question the assessment
Jan - Right, just because students question the assessment doesn't
mean that it's weak or invalid. They are allowed to ask questions and
to maybe that's a chance to validate it.
T.R. Does the class validate the assessment?
Jan - That's what we did with that notebook assignment. But I'm going
to be the ultimate judge.
T.R. - Is it inclusive?
Jan - I think so. When I think of myself teaching, I'm there to be the
guide. If they come up with some criteria that's way out in left field, I'm
going to say this is not legitimate, so let's change this.
T.R. - So are you the ultimate judge by being there?
Jan - I understand that part, but if they come up with something
outrageous, what then? (December 2nd, 1997, p. 2)

My questions, I thought, were directed towards Jan's realisation that she could allow
students to do more of their own assessments. Jan did little, at this point, to allow
students to assess in any formal or significant way. I continued to come back to this
issue.

T.R. - What things are you more likely to get involved in at this school,
things that exclude you or include you?
Jan - The things that involve me.
T.R. So if the kids were like you, wouldn't they welcome an opportunity
to get involved?
Jan - They may welcome it with open arms.
T.R. Now you'll always get 5 percent that will not co-operate.
Jan - Yes, they just sit there like bumps on a log. That's fine. And maybe
if the kids help me develop it, it will be in their terms and they may
respond to it much better.
T.R. You may want to delegate the tasks of bookkeeping the peer and
self-assessments.
Jan - That's something I'll have to work on. Would those students in
charge hand out the sheets and collect them? (February 4th, 1998, p. 3)

Jan often deferred to me, yet I was aware of this and attempted to ask her what she
would do rather than supplying my answers. Following the advice of Hopkins (1993),
I was trying to support and coach her as she thought about breaking out of her
established assessment practices, and the thinking that underpins them. Jan was changing each week as she consistently moved towards more varied outcomes-based assessment praxes. Jan explained:

I guess that maybe I could make more of an effort to try to introduce some new modes of evaluation, like you're encouraging us to do. But, I certainly wouldn't or could never picture myself going 180 degrees in the direction that you want me to. Maybe a little bit of both would be OK. But I think if you do too much peer evaluation, the kids don't take it seriously. It maybe... if you do it in small doses, then it might be effective. I think that if you went totally in one direction it would fall apart at the seams. I don't know, that's just me talking from my structure.

T.R. - OK, that's the theory; now we need to get the practice to inform the theory. We have known that theory informs practice and vice-versa.

(February 18th, 1998, p. 4)

Jan's suggestion that she felt pressured by my idea that self and peer-assessments should be increased illuminates the nature of action research as conversation tends to move people into action. This could be a negative if I had been too assertive. I felt that I had not, yet possibly I was not fully aware of the nature of my comments.

Nonetheless, Jan had developed new perspectives and self-knowledge concerning assessment and her assessment praxes during our months of discussion, reflection and action. Who developed the assessment in an outcome-based program was now seen as an important feature of empowerment, control, motivation, and fairness. I believe Jan was ready to move from where she was now to a new assessment paradigm by taking 'baby steps'.

In sum, I reasoned from our discussions that Jan had maintained a content-based assessment scheme that she adopted from her predecessor. She did this because it
was the easiest and most efficient means to produce numbers for report cards. It was a traditional means of assessment that students had become comfortable with, and had come to expect. Jan had limited preparation time and no opportunity to work with colleagues because of dissimilar work schedules. Jan had no formal assessment training. Hence she was uncertain, even anxious, about assessment. It was only through our group work and support that Jan felt comfortable enough to attempt to change her praxes, little by little, in order to make her assessment more contemporary and inclusive (utilising student input) as is customary in outcomes-based programs (expectations) (Griffin, 1998).

8.6 Assessment: Resistance to Change/Obstacles

Jan, as noted in the previous section, made small changes throughout our study. The following section addresses the research question that asks to what extent did these initial understandings and actual practices change due to the illumination of assessment praxes? Jan’s later transcripts contained several points of transformation. For example, when we moved into a discussion of peer and self-assessment, Jan found many points worthy of further examination, such as the development of a scoring scale. She pointed out:

The only problem that I see was the five points and their vagueness. I think you have to be pretty direct with these kids in terms of what they are evaluating. I could try to develop it with the kids and see if they will take it seriously enough. Some of them are not academically driven. Maybe, if I were to give it to them they would find it motivating. But if it goes awry, I’ll do it myself. (February 4th, 1998, p. 3)

Jan was applying her knowledge of student behaviour to new outcome-based
assessment efforts, though some of this knowledge could be used as explanations for
not changing assessment praxes. Carr and Kemmis (1986) add:

'Knowledge' is sometimes defined as 'justified true belief'. Not all kinds of knowledge we described in relation to teachers is 'knowledge' in this sense. It may not be true, it may not be justified, or it may not be believed sincerely by anyone. Paradoxical though it may seem, belief reaches the special status of knowledge only when it survives examination: when it can be and has been treated as problematic. (p. 43)

Each time Jan met with me individually or in our group, she revealed her underlying beliefs in the comments she made. During these moments of action research we problematized (Carr & Kemmis, 1986) in order to move from explanation to prospective action. Getting her thoughts out in the open proved to be empowering for all of us. This feeling then caused us to ask more questions. On one occasion, out of many, I probed Jan's beliefs.

T.R. Are you a good judge?
Jan - I believe I am. I don't know what criteria I have to base that against.
T.R. Have any of your colleagues said you were a good judge?
Jan - Good judge of character or just a good judge? I can't just pinpoint a point in time, the exact conversations. But there have been times when I've given my point of view and it's been well respected.
T.R. Have you had support for your judgements from other colleagues and can you tell us about them?
Jan - I think the fact that Cal, and Pat a first year teacher, come to me to ask questions -- they are comfortable and confident that whatever information I give to them they will be able to use in the classroom, um, I don't know, Bob and many have come to me, this means they value what I have to say. I'll have to be careful in the future I guess.
(December 3rd, 1997, p. 1)

The questions stirred self-reflection, and the process helped to facilitate
transformation by causing us to look into the future (Carr & Kemmis, 1986). Following this exchange, Jan wrote: "I did not really think about my leadership until you asked me but now I know that I am valued as a leader who can help others and I will continue to do so " (December 3rd, 1997, p. 22). Still, one roadblock to knowledge building and change was Jan's point that: "what I do now works, so why change? " Often I suggested that education is undergoing a transformation, with many new staff being hired and many new problems to face in our complex evolving society. Another motivating force for Jan to 'risk' changing her assessment praxes came from our discussion of government involvement and the use of assessment data to judge teachers and schools (teacher testing and provincial student assessments). Jan agreed that change was necessary. She was willing to change, if she had time, support, resources and the necessary behaviours from students. The group agreed to the purpose of searching for a better way and yet there was a pervading sense of powerlessness. Often, Jan deferred assessment to government policy. She often suggested we should take a "wait and see" attitude in some areas of the curriculum rather than a leadership stance. Her slogan might be "I'm just doing my job".

Jan - I think the Ontario Ministry of Education dictates the format for assessment.
T.R. So you are following a 10-year-old guideline? Are they valid?
Jan - I think the writing of the exam as a process prepares the students for University to perform under pressure, to analyse under pressure.
(January, 7th, 1998, p. 3)

It was not my place to tell her she was wrong, since I, too, would have answered with a similar statement. Often in Ontario education we follow policy in a top-down
manner. Still, what was assessed or targeted was important to all of us. Our discussions of assessment praxes led to the question of purpose (function): Why do we do this or that? What struck me on several classroom visits, and upon examination of assessment documents and materials, was the support for what was done in the past. The past included the dated Ontario Ministry of Education Science Guidelines (Appendix A), which were still being followed.

Throughout our study Jan was torn. She could choose to continue using traditional assessment praxes and available guidelines (which is all she had at this particular time) or she could continue to try out some elements of alternative and varied assessment modes. She provided many reasons for not changing, for instance:

> I like pencil and paper tests. For me, anyway, I feel it is the best way I can get a handle on whether the students understood the material or not. I like the factual tests, I guess, but yet I try to instil some practical applications so that it is not just rote memory. That way it will simply prove that they have truly understood the material and not just memorised words on a piece of paper. (October 8th, 1997, p.1)

In the quizzes and tests developed by Jan (Appendix O), knowledge recall was the primary skill required, as it was in her predecessor's assessments. This was due to at least five factors: Jan's isolation, limited time, multiple demands of the job, class sizes and structure of facilities. Indeed, "whatever a teacher is like on arrival at a school, at the end of the year that teacher is probably teaching like the teacher in the next classroom " (Smith 1988, p. 244). Jan often used other people's personal and commercial assessment materials. Hence, meaningful work becomes increasingly rare, as dependence upon published materials in the forms of programs, labs and
textbooks becomes the driving force (Smith, 1988). Yet, we vowed as a group to find a better way to assess, so our group often supplied supportive insight. We saw value in the outcomes-based approach, which was lacking in the content-based program currently used.

We continued our March 4th, 1998, discussion:

T.R. - The expert panel on Science recommended to the Ontario Ministry that assessment include . . . "journal, open-ended-problem, portfolio, interview, and performance assessments, should be used in addition to essay " (p. 14) Do you do this now?
Jan - No.
T.R. Is there value in doing assessment this way?
Jan - Well yes, but no, due to time. I'm pretty swamped right now and I think a lot of these things, like portfolios and that, are not done due to time limitations. And that's what prohibits us from taking on these new things. I know portfolios can be done in such a manner so that they are not a lot of extra work, but there is still maintenance. It's just not feasible right now. (p. 1)

Again, the need for efficiency took precedence over careful analysis of what was done and almost eliminated the possibility of change, I believe. Initially our plan was to illuminate assessment, yet once illuminated physical action didn't necessarily follow. Our conversations did cause us to discuss related matters at a deeper level but actual implementation (change) seemed elusive. Our study may be analogous to spilling paint: discussion (spill) was easy but implementation (cleaning up the mess) was difficult. Often an accident (spill) evoked an emotional reaction and some of these emotions surfaced in the form of tensions (turbulence) along the way.
8.7 Tensions

Smith (1986) suggests:

Teachers have lost the opportunity to be teachers, and students of all ages, especially children, learn that learning is difficult, pointless, and dull. Apathy, cynicism, and resentment pervade educational systems. And the situation is getting worse. New crises are being created as the omniscient outsiders expand their influence. (p. 237)

In the 1997-1998 school year, secondary teachers went on strike across the province of Ontario to protest the plans of the provincial government. It was a crisis that may have been artificially induced and many now cynical teachers believe the system will get worse if planned changes are implemented (Bill 160). We now have province-wide testing via (EQAO) and teacher testing is coming soon to make educators more accountable. Overworked secondary teachers are about to be assigned more classes to teach with less preparation time, hence tension is everywhere and not exclusive to our study. As noted earlier, the content-based program that has been in place for many years in Ontario secondary science classrooms is about to be changed with no inservice in sight for teachers. It is a stressful time for all educators.

Participants felt and examined the issue of tension, as it presented itself during the life of this project. Jan was already straining to meet government content requirements. She was also unaware of her own Board's (central administration's) assessment guidelines because she was so busy and lacked professional development. Throughout our study she struggled and this obvious stretching and straining was apparent. It was a common thread or bond that we shared.
In spite of the tension Jan was often outwardly joyful, smiling, laughing and generally like a beam of sunlight, even in January and February. This was enormously valuable for the group because there always seemed to be someone else who was not smiling, was quiet, or was angry and disappointed. It never seemed to be Jan. These opposing emotions were, at times, a source of tension. So, I wrote:

I'm very happy with the people in our group, as they seem to enjoy getting together and talking about assessment. Cal was tense in response to Pat's efforts today. I don't think they share common views on a lot. Time will tell. Bob is very much a leader who is assertive in a polite way and Jan is just plain cheerful. Today we had balance in our group. (October 15th, 1997, p. 7)

Block (1991) adds: "The fact that there is tension in the room means that people care about what is happening. When we drain the tension out of a situation, we have to be careful we have not unintentionally dampened commitment" (p. 203). Jan was very honest, I believe, and this allowed us to establish a strong relationship as we shared our thoughts and feelings. To illustrate this point I return to an April 9th, 1998, excerpt from a group meeting, where I ask:

T.R. Do you think this study would have changed if a superintendent had been involved?  
Bob - I think that for us we just see this as a vehicle for getting our day-to-day thing done, whereas the superintendent would see it as a broader across-the-system project.  
Jan - Yes, I think, maybe, unfortunately some of my answers would have been different -- not that I'm out to impress, I think I'd be speaking about things differently and wouldn't be speaking about the things close to my heart as I am here. (p. 1)

A second illustration of Jan's openness comes from an October 1997, meeting:
Jan - Actually, it is funny. In the evaluation scheme that I give them at the beginning of the year, 'Guidelines and Evaluation', I tell the kids, that as a group, if they are not happy with something that is going on in class, I encourage them to take time out of class, talk to me and we'll try to come to some sort of a solution together. It never happened though. The kids have never actually said 'look Miss we would prefer if you would change this, that or the other thing'. They seem to go along, maybe they are intimidated, and maybe they don't feel comfortable approaching me on that level. But I do leave it open to them and there is the odd time, particularly with my higher level courses, I'll say 'listen is there anything you dislike in the course, is there something in my teaching method perhaps I could change that you don't understand' and typically they say, 'no, no, that's okay, that's all right'. (p. 5)

Jan's attempt to decrease stress and tension in her classroom revolves around her direct, honest and assertive stance. Jan usually approaches a problem directly, as she did on a number of occasions when I was present. This allows her to make choices and retain mutual respect; her openness is a 'no lose' stance that says 'I'm OK. You're OK.' Jan wrote in her journal:

I have always been a person who says what is on my mind as clearly and directly as possible. I don't always get what I want but this is the approach that has served me best so far. I believe I got this through sports, as you can deal with things on the field directly and when the game is over you feel good about your efforts. I do the same off the field. If there is a problem it is something that a student has allowed to exist or is unwilling to deal with. I'm always ready to help. (October 15th, 1997, p. 8)

Jan's approach was appreciated by each member of our group and I believe our group would have been less productive without her. Jan told members of our group how she perceived many events throughout our study. For instance, when Jan talked about Pat possibly the most pointed message was made. For me, this was one of these 'moments' of action research. On April 9th, 1998, Jan confessed, following my
question.

T.R. Do colleagues bother you at times?
Jan - You talked to me on a couple of occasions..
Pat - Oh tons.
Jan - . . . about the frustrations she has had the odd time. I've been able to
give the odd suggestion but sometimes it's just a venting thing, right?
And I think it's healthy that she does talk to me but if Pat was coming up
to me every single day, 3 times a day, and giving me a different
scenario; you know what I mean? I would almost see that as an abuse
and I think that would get a little tiresome, but she only does it
occasionally so that when she does talk to me then I give her the open
ear; Do you know what I mean? (p. 2)

Jan's openness was refreshing and could have been a source of turbulence but our
group respected her insights and often agreed with her assertions. Jan's messages
were practical and served as realistic benchmark for interpersonal issues. There were
times, for example, when I presented my views that Jan became aggressive to the
point where there was uneasy tension due to her reflections. For instance:

Jan - Let's go back to the first thing you were saying. You had
mentioned that we should try to evaluate by peer, teacher and self.
Okay, ideally that would be a nice situation but, for instance, with my
OAC course, here I go again. I find it so content driven from the Ministry.
T.R. But it's your classroom.
Jan - Yes it is, but there is still the content that you must get covered
over the course of the year.
T.R. Who checks?
Jan - They check exams and they take a look at the exams to make sure
that they are up to provincial standards. (October 8th, 1997, p. 8)

Jan felt stretched. In order to complete the course, as it was laid out by the Ministry
of Education of the Province of Ontario, she would have to teach, test, teach and then
test repeatedly (every unit). Jan had little time to explore various forms or question
the function of assessment, let alone anything else. Content for her meant covering the topics, passing on the information and then testing to see if they knew it. From her position it would be a struggle to jam everything in and then assess again during a mid-term and final exam. The tension was always there, so she could not afford to deviate from what was required. Jan knew what was required and she was attempting to achieve it. Clearly, her feeling is that this Governmental (external) control of content gives teachers little choice but to teach to the tests. We continued to talk:

T.R. So, that's the exam, which is one event in a whole semester.
Jan - 30%
T.R. But it's only one day, the rest of the time 70% - you could do pretty much - you have a lot of freedom.
Jan - A lot of freedom, but yet it's fairly driven, like I don't, again this is only my first time teaching the course, so Sally gave me her binder and I tend to go from that. Maybe in the next few years when I have taught it numerous times, maybe then I may be able to loosen up a bit, but right now I feel okay this is what I have to get done this week and this is where I am going with it. I don't feel like I am throwing my own creative spin into things and maybe that's not justice to the kids but I feel like that's the only thing I can do right now to actually keep my sanity and keep going with the course. (October 8th, 1997, p. 8 - 9)

Jan felt the pressure to follow in someone else's footsteps. The binder was passed on. If she tried to develop her own it would mean she would have to work long hours after school to prepare materials for the following day. She opted to use materials that were used in previous years. This allowed her time to do other things. Assessment was only the tip of a large tension-filled iceberg. Jan told me about an instance of marking.
T.R. - Isn't the assessment, the creativity, an integral part of your program?
Jan - It is important but I don't find it's truly reflected in their very final mark just the way I do things now. Even when I mark those projects on mitosis that I told you about, I'm sitting there trying to mark out of ten and I thought to myself, what on earth am I marking here out of ten. So I'd look and I'd figure, okay, is it readable, is it presentable, someone walking into the room, can they make sense of what's on this piece of paper? And if they could they would get five out of ten and then whatever extra little individuality they put onto the paper, I would give them a couple more marks, but it's just so airy-fairy, I prefer structure.
(October 8th, 1997, p. 9 -10)

Jan pinpoints another source of tension for her, which involves assessment. She often is confused about the construct (trait) or target of her assessment hence an area of improvement is identified for her. Jan has realised how important it is to decide on assessment criteria before she begins to teach and certainly before the task is handed out. The 'airy-fairy' aspect is a source of tension as it is opposite to what she likes, structure. I found that our interviews and group discussions were very revealing to the point that I found myself rewriting what had just transpired in the interview. Jan herself wrote:

"I like the way our group is making connections it seems as though we are growing together and we now are more allied than before. Still we have to learn to accept the fact that many of the assessment methods we are using need to be improved and new ones need to be used. We have an opportunity here — I hope we don't get defensive and stop what's happening. (November, 12th, 1997, p. 15)"

Jan brings up a source a tension that I had been aware of yet had slipped my mind. At any time in our study participants could drop out, and I was fearful of this. I also was hopeful that our group would 'gel' as we worked through this process. It was interesting to read the journals as they conveyed interesting perspectives. Jan
confessed February 18th, 1998:

Sometimes when we have a [action research] meeting, I think oh, no I have other things to do, blah, blah, blah and I do bitch about it, ha, ha. But, I find the things we have done, it’s made me open my eyes and think about things. We even talked about it ever so briefly, I’m not saying we spent the whole night on it — Bob is doing something practical with his OAC physics class and he said chances are if we were not meeting in this format he wouldn’t have thought to do this practical aspect even though you may get negative vibes from us at different times I think overall it has been a good thing. I don’t think it has totally changed us but we are finding it easier to do new things. (p. 4)

I sensed an apologetic tone. However, I was more concerned with the fact that Jan was offering real feelings. On April 9th (1998) I asked: What are the barriers to action research? Jan answered openly and honestly:

It depends on the days. Some days you are more stressed than other days and just taking time out of your day to meet sometimes can be stressful, that would be one of the things. Sometimes I look at the week and say do we have a meeting or not. If not, then we have extra time, you are taking time so that may be a little bit of a hassle.
Bob - Basically, you have to make it a priority.
Jan - I look at the meetings differently now than I did in the beginning. When I first started it seemed like it was fresh and new, it was a little more exciting. Just the last month or so I found it a little humdrum, and it’s not a reflection on you, it’s just we are meeting in the same environment — I hope it’s not coming out really badly. Is it? (p. 1)

This was an opportunity to explore an admission, support it and examine it. We had done this many times in the past. Jan was very busy, tired and her level of tolerance was diminished due to her fatigue, which is common in teaching during the later months of a school year. It was true that what was once new was now quite familiar. We had become experienced in the self-reflective spiral that links reconstruction of
the past with construction of the future (Carr & Kemmis, 1986). However, it was very much up to Jan to make her next move. Perhaps she was saying that it was time to end the study. After seven months of work and a two-week provincial strike, coaching, teaching six of eight periods this year, Jan was ready to fold up her tent and move on. I respected her candour and by the end of April we concluded our study with a sense of accomplishment.

We now had a good sense of each other and our insights and collaborative work had brought us closer. Yet this closeness could also spark tension and disagreement. Each of us had built close relationships over time and this 'history' with one-another could be a source of turbulence. Carr and Kemmis (1986) remind us that "through the action research process, action researchers thus become aware of themselves as both the products and the producers of history " (p. 187). Our history was filled with 'action research moments', which generated interesting products and vivid memories of a process that will long be remembered. There were still opportunities for Jan to build self-awareness. She told us that our work had become somewhat of a focus for her even after-hours, in spite of busy schedules. Jan was now also aware of what others were doing most days. She sustained a feeling that she was moving toward something better because of her experiences with our group. Indeed, participants had chosen to complete the study in spite of the way it obviously took up their valuable time and placed demands on them. It could be that each of us knew of the need to be more self-aware as we taught while enduring and confronting sources of stress (time, instructional decisions, student behaviour), dilemmas (values, beliefs)
and tensions (administration, colleagues, parents).

**8.8 Assessment Praxes: Perspective Transformation**

Jan's impetus for transformation came about when she had a chance to listen to others speak about how they had changed or wanted to change their assessment praxes during our study. It was through this process of socialisation that Jan's reflexivity was observed and noted. Eventually, Jan offered her own rendition of the new assessment praxes needed in 1998-1999:

I can see myself this summer thinking about assessment first. Last year I thought about planning and teaching, and assessment was an afterthought. Now I'll ask myself and others 'what am I assessing' [target], what should it look like [form] and who should help me with it [function]. I would be more of a support to students instead of just someone who talks about what is in the textbook. My course would be more real and have a lot of problems that need different resources to solve. This summer is a good time to do this when my head is less crowded. (April 15th, 1998, p. 50)

Jan was telling us that she would move from a content-based program to a more outcomes-based program, with varied assessments. In a sense her action strategies suited her particular context. Jan was near the end of a stressful year and had received supportive professional help in the area of assessment during 1997-1998.

Altrichter et. al (1993) point out:

The term action strategy needs to be understood in terms of the following provisos: - Complex social situations are not changed by one single action. Usually, an action strategy will consist of a number of co-ordinated actions planned on the basis of the research. - Do not expect immediate solutions. Change is usually a long-term process, in the course of which several single elements of a system begin to move and action strategies have to be adapted and modified. (p. 159)
Our group discussion offers some evidence of this. Bob requested our next meeting, after four months of discussion, be a working meeting for peer and self-assessment development. This was a small change or step in the process of change. To this point, our work could be labelled largely theoretical. Now it would become more practical and applied (concrete), as we began to construct new assessment tools.

Bob - It's kind of exciting to see something new -- boy, I'll tell you.
Jan - Yes, something tangible and not just theory.
Bob - You have to be creative to come up with good assessment.
Jan - The criteria has to be accurate and useful.
T.R. - We think critically, but we don't write it down. For example, shopping: you buy this because of these criteria and not that due to this reason or criteria.
Bob - This is good for an assessment tool. It can be used for presentations to make them more meaningful. I don't know if they'll get more out of it, because not only is the presenter getting something out of it, but also the whole class is going to, because they are assessing.
Jan - It's good for presentations and it's non-traditional. For years the kids have been assessed by the teacher alone. It gives the kids an opportunity to be involved and have input. (February 5th, 1998, p. 4)

Our group felt we were moving into a new assessment paradigm (outcome-based).

We were leaving behind a content-based model where a narrow source of materials is used (textbook/lab manual). We were attempting to leave behind the belief that we needed to teach students a fixed body of knowledge to achieve or retain a predetermined course of learning as indicated via various tests designed to assess their knowledge (retention). Instead, we were challenging participants to become lifelong learners by teaching them how to assess. Jan noted:

I see myself moving. First I think and then pounce. It is kind of subtle and slow but as we talk I find myself nodding my head and if I were not
in the study I would not be nodding. I would be making up the next assignment or marking or some other good stuff. Even when I'm in class I have to stop when I do something that we have talked about in-group. The other day I asked another student to mark a lab for me, this is new for me usually I do it all. After I went over it and it was pretty good [the marking]. (March 18th, 1998, p. 41)

The action research group stimulated a course of action, which can be described as a move to self assess, that otherwise would not have occurred. The move through self-assessment was quite successful and became the target for many of our discussions. Cal noted:" I use self-assessment more now, than before, only because I have learned more about it through our discussions, and because I know it will be in the new curriculum “ (April 7th, 1998, p. 34). Hargreaves and Fullan (1998) add, “ Once teachers have developed some shared confidence about their assessment judgements, they are likely to feel more self-assured (and paradoxically more open) when discussing any particular assessment decision . . .” (p. 98). All participants said they felt more secure about assessment matters and were more inclined now to change their practices over the next few months. I made this point on December 18th, 1997.

T.R. - Are we changing our ways of assessment slowly?
Jan - I wouldn't have tried a new way to assess if I had not been meeting in this group. (p. 3)

By February 18th, 1998, we were into a phase of acting once again. Jan summarises:

Well, at our last meeting we worked on a self/peer-assessment tool together. I went to the class after you gave me some hints as to how
to do this. I went to the class and they created this assessment tool. I went with the 'Never', 'Sometimes', 'Usually', 'Mostly' and 'Always' descriptors as anchors for the scale. I presented this to the kids and then I allowed them to come up with 5 points that they thought were valid in terms of evaluation in a lab setting. I didn't reject anyone's ideas. A couple of kids came up with things and we moulded them together. They came up with two separate points and I put it into one. It was actually quite similar to the one I had done up, except I didn't present that to them. I didn't want to bias their opinion. Actually theirs was better than mine was, and I told them that.

T.R. - That's good for grade 11 general.
Jan - Yes, grade 11 general. (p.1)

The need to have teachers collaborate with students who are developing and learning about alternative assessment modes is quite important (Hargreaves & Fullan, 1998). As Darling-Hammond (1998) suggests, “Teachers need to be able to analyse and reflect on their practice, to assess the effects of their teaching, and to refine and improve their instruction” (p. 1). There is no doubt that Jan's beliefs and knowledge changed as a result of our inquiry. She learned, for example, that students could develop their own assessment tools if they were given the opportunity, guidance and support. She learned about terms, definitions and words specific to contemporary assessment, as the following exchange illustrates.

T.R. - Did you use exemplars?
Jan - I don't know what they are.
T.R. - Exemplars - usually it means provision of an example of what is expected or a standard expectation for the task or process. It lets students know what it should look like before they start.
Jan - Like the perfect lab.
T.R. - Yes, but it doesn't have to be ideal, often just realistic and a credible effort. (March 4, 1998, p. 2)

Jan soon became a frequent user of exemplars and by the conclusion of our study
she was passing this knowledge on to colleagues. Jan wrote:

At the start of our project I felt less than helpful but as we talked about assessment I became more confident in assessment, and this made me feel more helpful. (April 14th, p. 49)

Jan's experiences included a number of realisations. She began our study as a traditional teacher-centred content-based assessor, yet moved cautiously to change her praxes to include more student-centred outcomes-based program, which varied her assessments. Jan was honest, communicated her needs in public, and spoke candidly in our 'open' forum. I believe Jan achieved this, in part, due to the supportive nature of this action research. It was also due to the 'group' context in which we worked. Because of this, participants found better ways to assess, communicated openly and found new levels of assessment confidence. Overall, "teachers learn best by studying, doing, and reflecting; by collaborating with other teachers; by looking closely at students and their work; and by sharing what they see" (Darling-Hammond 1998, p. 1).
Chapter 9

Pat: Past and Present

Introduction

Chapter nine contains several images of Pat as a participant and first year teacher. Pat's images create an identity for her as she strives to increase her knowledge and understanding of assessment. It is through these images that rationales are connected to emerging themes. The themes and rationales were generated via our data. Data included illuminative discussions, journal notes, collected artefacts (tests, exams) and classroom observations. Our bouts of reflection served as a means of professional learning and much of our work culminates in the final sections where the images of Pat's assessment praxes are described as a search for competency and identity as a first year teacher.

9.1 Assessment Praxes: Preservice Experience

Pat and I usually met for one-to-one sessions in one of three science laboratories at the school. Since Pat had a copy of the meeting schedule she was 'ready' when she needed to be. I would arrive on time with tape-recorder in hand and we would commence our discussion focused on some aspect of assessment. This scene played out for most of our meetings, yet on a few occasions we were momentarily interrupted by some other staff member who came into the lab to get supplies. I would usually meet her during a preparation
period, before class or after class, which meant that the room was quiet enough or empty enough so that our tape-recorder could pick up our conversation without interference. We never had technical difficulties with our tape-recorder and each of us became comfortable with the format. Pat wrote in her journal.

I was not too crazy about the recording of what I said at first but since I will be hidden behind some pseudonym as well as the school then I guess that's good enough. It makes me feel what I say is important and I don't know if I'm ready for that. (October 30th, 1997, p. 17)

This entry struck me as honest and assured me that the data recorded would also be honest, sincere and heartfelt. On most occasions our discussions seemed to go beyond the allotted time because we were both engrossed in our conversation. This always left me with the impression that we didn't have enough time, yet it was probably due to the fact that we had so much to discuss in the area of classroom assessment.

We discussed preservice training and its aim to expose students to theory, methods, and skills. We reflected on our school placement experiences, which provided opportunities to apply preservice learning. We discussed the amount of effort a first year teacher requires. (Wideen, et al., 1998). We also discussed the alternative-based preservice program modes, which might include action research (Carr & Kemmis, 1986; Sagor, 1992) and reflective practice (Schon, 1983). As we reflected, it became apparent that Pat had experienced a mix of both alternative and traditional preservice training. I
wondered to myself: Was it a consequence of this preservice experience that certain opinions and beliefs developed within Pat? It seemed as though Pat's beliefs had come from an earlier stage of her life. If so, this supports the assertion of Wideen et al. (1998) who point out that beginning teachers enter preservice teacher education with firmly held views about teaching (p. 168).

The notion that graduates of preservice programs may enter the workforce with previously developed beliefs and values concerning teaching is useful to veteran teachers, teacher educators and researchers who might try to work with first year teachers. The preservice experience can then be viewed, by participants, from a highly critical stance. It can be perceived as a less than valuable experience. Indeed, beginning teachers are little influenced by the interventions that occur in preservice teacher education (Wideen et al., 1998, p.168). This may be because the teacher in training often devalues preservice and puts forward critical images of the experience when reflecting upon it, just as Pat noted in her journal early on:

The Faculty 'process' of training teachers is not really valid. It is too subjective; it takes you down a path and asks you what you think along the way during the journey or asks you to reflect at certain endpoints. I didn't have an answer; it was too much reflection and not enough reality. I knew what teaching was and what it wasn't. At the Fac. of Ed. we talked about what if, and why and most people turned off. I woke up when I worked in classrooms and had to perform. (October 14th, 1997, p. 12)

Pat wanted more practice teaching in preservice. She valued it more than the theory she was exposed to in preservice. According to her, reflection in
alternative based preservice programs is an overused practice. This seemed to be a frequent theme for Pat as she reflected on her days as a student at the Faculty of Education at the University of Toronto. During an October 1st, 1997, group discussion, in response to my question about assessment while in her preservice year, Pat recalled what assessment was like for her.

Pat. - In the Faculty of Education, if you are breathing! I don't know. Cal - Maybe in your school, but not in our school. Bob - [Laughs.] Pat - OK, if you ran around, too! A lot of it has been very cognitive, very little creativity and, well, group work - I'd say a lot of people assess group work very superficially. I mean, did you work? Great there you go, you got a 'A'. I mean, if you didn't break any windows, there you go, you got an 'A' in-group work. Assessing group work might be very, very subjective and it depends on how people work. Together, some people can do that and other people can't, I don't know. I just find it fairly subjective in class group work. I found I wasn't assessed that way in University at all. There is no creativity part at all. It was how you communicate and how you can write. It's hard to focus on the assessment. The assessment this year has been interesting because how to word a question and what they comprehend from the question . . . just from the assessment you can tell how the person thinks. I mean, yeah, they wrote something, here's an 'A'. And if you give them less than 60 percent, everyone complains. I'm not very happy with the grade 9 assessment; it's very different than the grade 10. You go from one step to the other so quickly. (p. 1)

I matched Pat's critical responses to the insights of researchers such as Wideen et al. (1998), who suggest that:

Future work [in the area of preservice program development] must systematically challenge myths that underpin most current programs of teacher education and focus on the structures and the ethos that must be created to assist beginning teachers to examine their beliefs and to understand how to support new practices that are consistent with their changed beliefs. (p. 169)
I thought that the points made in this quote were essential to our discussion and I shared these with Pat, who laughed at their accuracy. Secondly, we thought that until these changes are made preservice teachers might consistently graduate with similar beliefs. For instance, Pat decided that the year invested at her Faculty of Education had not paid dividends. Clearly, not all in our group shared her opinion. However, I found a means to understand not only Pat's position on this question, but others' as well. My understanding became clearer once I had made attempts to decode Wideen, et al. (1998), who astutely point out that "... preservice teachers do not typically develop new perspectives, [they] simply become more skilful at defending the perspectives they already possess" (p 142). So, Pat was in a defensive and highly critical stance, as she suggested her preservice program required only 'breathing and running around' as criteria for passing. This opinion of Pat's was probably related to the views of some preservice teachers who suggest that "... teaching [is] something one does, not something one ponders" (Wideen, et al. 1998, p. 153). Therefore, sitting idle in a Faculty of Education classroom, quite removed from the 'front lines of teaching', caused Pat to be uneasy about her teacher training and some aspects of teaching in general.

In spite of her preservice experiences, reactions and impressions, Pat was, at this time, confident, yet frustrated in most areas of teaching -- including assessment. Within the group setting Pat often vented and seemed to be somewhat annoyed.
Give me something concrete and I'll run with it. I'm not a cadaver. I did self-assessment and I did peer-assessment and the group said I got a 100%, everyone got 100%. I had just as many discipline problems. So, to say the old way is, I'm not saying all is good, there are a lot of problems. But a lot of people are incorporating a lot of things. I think the new method is very illogical in a lot of areas. Whereas the sheet of paper saying do A, do this, here's a handout, be quiet, boom, I mean until I can get some of that, I mean content is very important. (January 22nd, 1998, p. 4)

Obviously there was tension (see: 9.5 Tensions) in the air as Pat addressed some of the frustrations she faced in her classroom. I asked myself if she was just making a case for giving up her ideals in favour of traditional practices (content-based program), as noted by Rosaen and Schram (1997) in their study of first-year teachers. Clearly, Pat supported a content-based program. Content-based programs offer a series of lessons that are regimented and cause students to follow a predetermined course of learning (Griffin, 1998).

Pat viewed herself as a transmitter, there to deliver a body of knowledge. She wrote:

In order to lay down the law in class you have to know your course of studies inside and out. Because I do I find it easier to take care of the behaviour of the students. Both of these areas are of interest to me. If I control their behaviour then we can deal with the content. If I can take control of the content then I can deal with their behaviour. (November 19th, 1997, p. 21)

This preoccupation with control (discipline) is well documented in the preservice literature (Rosaen & Schram, 1997; Schoonmaker, 1998). This
insight may also be applicable to first-year (novice) teachers; it certainly seemed to be so for Pat. Later, during one of our many group discussions, Pat explained: "I'm the boss, I can make the rules and if you don't like it too bad, ha, ha, ha" (November 12th, 1997, p. 3). Pat then complained that grade 9 assessment was not ideal, but rather too subjective or easy, and grade 10 was too difficult, too large a step from grade 9. It could be that Pat might be experiencing challenges to some of the idealism created in preservice or even before preservice, while Pat was a student. Her current dilemma created serious problems and confusion for her (Wideen, et al. 1998).

Pat thought her Faculty of Education experience was enriched by her practicum. However, she felt that away from the practicum, in the areas of study that are more theoretical, there was less value for some teachers, who view it as too detached from practice. Indeed, Schoonmaker (1998) suggests “the literature tells us that if . . . [a person's] development as a teacher is typical, she will leave the university with the conviction that theory is abstract and unrelated to the realities of teaching” (p. 562). The merits of this observation were explored in our group. Pat offered this insight concerning the development of assessment literacy at her Faculty of Education.

T.R. Did classes in assessment help you?
Pat - Nothing was good. Science was not bad and they did some assessment. Math was a total waste of time. Special Education was eight hours of 'there are special kids out there and don't worry about programming because the special education department will look after that.' Obviously they don't, because I had to do it. Discipline, we played with pom-poms and found out what type of personality we are.
Law was not bad: This is the law-bang-bang-bang. That was half-decent. The psychology was useless. He told us stories about how he grew up on the prairies. He was about 80 years old. The TSS course was off the wall; she didn’t open her mouth the whole time. She told us her life. It was a really a huge waste of time.

T.R. So, how would you change the year at the Faculty of Education to make it more useful?
Pat - More practical exercises, such as making tests for grade 10 science. Stuff the reflection; we had reflection right out the wazoo.

T.R. OK, the assessment classes were not useful, so your practicum was time well spent?
Pat - I’ve got a strong science background and fairly strong math background, so they let me walk in and do things by myself because I was confident. It was teacher-to-teacher level and not teacher-to-student.

T.R. During your placements, did you use any alternative assessments?
Pat - Not portfolios, but self and peer-assessments. (January 7th, 1998, p. 3)

Pat, in fact, saw most of the preservice year as a waste of time, with the exception of her practicum and one or two of her professors. This highly critical stance towards the Faculty of Education can be linked to the striking contrast between what is done in preservice and what a teacher’s needs are inservice. Therefore, the hindsight becomes quite cynical and some may say that "all is lost if teachers succumb to pessimism and cynicism" (Hargreaves & Fullan, 1998, p. 58). Yet, Pat was determined to overcome this pessimism. One means to overcome it was to be quite forthcoming, and I supported this virtue as best I could, as did our group. I noted in my journal early in our study:

Of the five participants I find that Pat is the one that stands out because her insights seem so much out of 'sync' with what the other four are saying. I include myself as part of the other four. It is almost as if we four have become part of the established view and Pat brings in the alternative. I don't quite know how to describe it — I guess I could just say she is a first-year teacher
who has yet to become accustomed to certain ways and means in education. (October 10th, 1997, p. 2)

Pat reflected on her experience of being assessed and came to the conclusion that it was mostly cognitive and narrow. By this she meant traditional content-based assessment, with paper and pencil methods. Assessment, as she experienced it, did not involve the application of skills or varied tasks from each of the three domains (psychomotor, cognitive and affective).

Pat viewed self and peer-assessment as less than adequate and not a valid way to assess either in the Faculty of Education or the classes she now teaches. Therefore, her assessment praxes involved many of the tools she was most familiar with and coincidentally believed in, such as multiple-choice, fill-ins and short-answer objective style questions. Pat's assessment praxes seemed to be a perpetuation of what has been done traditionally in assessment (Appendix P). Her influences have been her experiences as a student. Smith (1988) explains:

Professors in faculties of education have told me that student teachers are not 'ready' for theory — and that most practicing teachers are not either. These professors argue that student teachers must be given 'survival skills' to get through the day and that they must be prepared for the way schools are, not for the way schools ought to be. Teachers, like students, behave in ways that reflect how they have been taught. (p. 126-127)

If this insight had been available to her, Pat would possibly have graduated with a better impression of the Faculty and its educational program. Pat's
assessment praxes closely matched those of her predecessors. However, as mentioned, Pat had been hired close to the beginning of the school year. Consequently, she felt under siege and was attempting to "ground herself" by doing what was easiest, given the multiple demands of the job.

9.2 Search for Competence

Pat, being the newest staff member, had many interesting perspectives on the role of a secondary science teacher and possible indicators of good teaching. For instance, on December 3rd, 1997, we had the following conversation.

T.R. What criteria would you have that makes a good teacher?
Pat - 1 Competent in their field, 2 Industrious, 3 Creative, 4 Energy, and 5 Patience; I think that's it.
T.R. If I said to you: "A good teacher is one that wears a blue shirt." Would you wear one?
Pat - Yes, I would. (p. 3)

Pat was the kind of staff member Principals look for, because of her enthusiasm, dedication and innumerable skills suited to the job. I was not the only member of our group to appreciate Pat's efforts. Jan stated in an April 9th, 1998 group discussion that although Jan had trouble transcending routines, Pat seemed less constrained.

I found that with a couple of courses I've taught, it has served as a limitation — I'm teaching a new course, and to learn the content was impossible. I follow the plans I've inherited. That's what impressed me with Pat this year. As a first year teacher she has a binder. She is just not getting through the stuff as I did. She is making a lot of changes, and including computers. She is using
some of the same labs, but I found that she is kind of a breath of fresh air for this particular Biology course. I think that's great. It might encourage me to do some new things. There have been other courses where I have been limited by the binder. I just kind of use it to get through the day and the semester. (p. 4)

Pat was willing to do whatever it took to develop her professional expertise and comments like Jan's helped Pat establish her professional identity. Beginning teachers can choose to follow many paths that are influenced by any number of people. The choice to follow a certain path is ultimately due to their own beliefs concerning notions of competency (good teaching) (Rosaen & Schram, 1997).

The notion of competency is elusive, and each of us may have different beliefs that emerge and become apparent to other educators. It was not my place to suggest what good teaching was; it was, however, my place to question current praxes in order to precipitate reflection and discussion. I offered the thought that some educators might believe that only they are doing a good job because they lack insight into other educators' efforts. Jan wrote:

I am doing a good job and I know it because the students are happy, the administration is too and no parents have complained. I don't need others to tell me I'm doing a good job I think it is a feeling you get when you put effort out and people appreciate your efforts. I'm doing 110% and that's all there is. To do more means they don't see my efforts, that's it. (October 30th, 1997, p. 17)

Pat had demonstrated that she had both the ideas and energy to break free of some of the previous classroom routines. However, she also found it necessary to follow some of the established classroom assessment practices. It could be
that Pat, upon facing isolation and the problem of 'overload' (Fullan & Hargreaves, 1991), was abandoning some of her ideals in favour of traditional practices or copying others without critically reflecting on what is observed. It is tempting for young teachers to try to emulate experienced ones because they see someone apparently experiencing none of the problems they seem to encounter. In other words, some veteran teachers inadvertently "... reinforce the myth that 'good' teachers encounter few if any uncertainties in their everyday practice and by mitigating against raising questions about practice of self and/or others, the culture of teaching promotes isolation and the virtue of self-reliance " (Hannay, 1998a, p. 19). Pat shared her thoughts about competency once more, on March 4th, 1998, during a one-to-one interview.

I'm competent; I've been trained. I've been doing this a long time, not specifically science, but teaching for a long time. I can tell maybe better or worse, there are slight individual adjustments for each person to get assessment to a point where people are really learning to whatever capability. Then I'm doing my job. I don't need someone saying I'm doing a good job. But I'll go to Jan and say: " when you did the test, did you ... ? " It's an informal approach, it's: " How did you do it ... ? " " What did you think? " And that feedback will go in. I'll make my judgements accordingly. (p. 2)

The first year of teaching may be a first step along a continuum of growth, yet it is turbulent as there can be " information overload, lack of planning time, excessive workloads, and a lack of training for the grade assigned " (Saskatchewan Teachers Federation, 1992, p. 5). The reasons for this are many. Beginning teachers are apt to view teaching in these circumstances
"... as the simple and rather mechanical transfer of information" (Wideen, et. al 1998, p. 143), as in typical content-based programs. However, in spite of these obstacles, a first year teacher is refining, adjusting and shaping their new role in order to reach a certain comfort level. In a sense, it is a discovery of oneself. Take, for example, this reflection of student reaction to teacher assessment praxes that Pat relates from a group discussion from October 1st, 1997.

With assessment, they have to know that they are getting a mark for it. My philosophy was, if you perform on the test, fine. I mean, the homework is a way for some students who don't do well on tests to get a series of marks. But in the first week, I assigned homework, and it wasn't done. It wasn't done unless I checked it. So, the next week I checked it every single day and now, when they walk into class, they have their work completed. They say: "look, look." (p. 6)

Pat is looking for the same thing the students are: some recognition in the form of her students performing up to her standards. Similarly, Pat is using their performance on her tests to provide an indication of her success and competency as a teacher. In a sense this is her 'meter of accountability'. If a student does poorly she may associate that outcome with her teaching. This type of conjecture comes from her reflections, which form a truth and reality for her. A student's lack of effort or consistency was viewed as a problem that needed to be solved. Pat was finding her way through a complex maze, as this excerpt from October 15th, 1997, suggests:
For a review session we went over seven questions in detail. Right from the book. I used the exact same questions on the test because part of what I wanted to see was how well they were listening and interacting orally working in the class. Obviously they were not, when you get marks of like 2 — there's one section of just five definitions, one chart that they already had and I told them to study for the test, T-E-S-T, nudge, nudge, wink, wink and they flunked. The average was really low so, but then there are 5 or 6 who got 99% on it. But they get 99% when I give them the question and 99% when I do not, so I don't know what to do with them — they are just out of control. So they go from 64 to 80 to 64 to 40%. (p. 1)

Pat has also located a generalisation suggesting that if she doesn't acknowledge them, they will not acknowledge her assignment or her. It's reciprocal. One action begets the other. As Pat refines her knowledge of teaching, education and students, she will change. Moreover, her "change involves values and purposes associated with what is being changed. Will it be helpful or harmful?" (Fullan & Hargreaves, 1991, p. 19). Only time will tell.

Pat believed, above all else, that teachers needed to know the content. This was a simple view that made sense because she saw teaching as a transmissive act. This seems to be of paramount importance in her. Pat wanted students to learn and understand the content and she put a great deal of effort into reaching this goal. On several occasions, while visiting her classrooms, I made this kind of note:

Pat uses the text to guide her and every chapter provides a unit of study with few outside resources. She likes to teach from her strengths and tests done two weeks ago are handed out with little reaction from the students. Pat is highly verbal and really talks
most of the period, giving directions, answering questions and
telling people what to do. She uses a planning, teaching and
assessment order that is quite traditional, in fact it reminds me of
the kind of courses I took when I was in secondary school. I find
it hard to sit on these stools for 70 minutes. The overhead is
useful, but Pat covers material very quickly to the point that I've
lost her messages. (November 12th, 1997, p. 14)

Pat was demonstrating what is found in typical content-based programs. So, if
the content was not learned by students a teacher may believe that it was
somehow their fault. A teacher may believe it was some quality that they didn't
possess which somehow contributed to the lack of content knowledge of
students. Fault or blame can then be fixed on both parties, which creates some
confusion. Glasser (1990) reminds stakeholders:

Almost everyone in our society shares a huge misconception
about teaching. By 'everyone' I mean not only the general public;
but also teachers as well as parents, administrators, school board
members, politicians, educational news reporters, and even the
college professors who run teacher preparation programs. What
almost all fail to understand is that being an effective teacher may
be the most difficult job of all in our society . . . . An effective
teacher is one who is able to convince not half or three quarters
but essentially all of his or her students to do quality work in
school. (p. 14 -15)

The teacher as motivator, intriguing and inspiring students to produce quality
products and improve themselves via classroom experiences, seems to be
Pat’s vision of teaching. However, the issues concerning a lack of time,
multiple demands, and the newness of the occupational role, reduced her
ambition to that of merely surviving. The Saskatchewan Teacher’s Federation
(1992) validates this finding and further suggests: " it is well known to be usual
and predictable in first year teaching, to experience phases of anticipation, survival, disillusionment, rejuvenation and reflection " (p. 9), phases which may be random. They can also assume various lengths of time in teachers' lives. In the October 15th group discussion, Pat speaks to her many feelings as a first year teacher attempting to come to terms with an assessment phenomenon, student motivation.

T.R. They're not motivated?
Pat - No, not motivated.
T.R. - Would it have helped if they developed the questions?
Pat - Well, that's what we're doing today; we're having a quiz. I made it up, but they are making up a test themselves for next week. So for the next couple of days we're going to quiz every day, somebody's quiz. So, it may be they'll do better that way. (p. 4)

Pat was beginning to examine the reactions of students who were not learning the content or doing quality work. These students were not motivated. This, in part, was due to a dated and imposed curriculum rather than one that encourages or involves them during the development, implementation or assessment phases. She is seeing a consequence of student curriculum exclusion, especially concerning assessment. I believed that if students were invited to play a larger role in the assessment, and in other areas, interest and motivation would look after themselves. Choice and self-direction are motivating for most students. I continued to probe by asking, "As a consequence of this experience how will this motivate you to do some things differently? "
Pat - Well, not rely on very much oral. They don't respond well. They might after they realise that they were given the questions. Honestly, I didn't see one light bulb go on!
T.R. - Is that grade 10?
Pat - 10, ya. I think they have a lot of work right now and they're not used to it. Actually, I think they are good students, but they're just a little frustrated right now. They have so much work to do, because there's a big difference between grade 9 and 10. They don't have the work habits. The last two tests I had really concrete reviews, very structured. I even gave them a chart with all of the terms they had to know. And all of the information they needed to know. They still had about a 60 percent average.
T.R. - Do you think some of the students are rebelling, by not doing well on the assessment, or is this true indicator of their ability?
Pat - It depends what true ability is. I think it depends on work habits, as well as retention. I think there are a lot of students who potentially could get higher grades, like one student goes from 50 percent to 95 to 50 on the next test. That's the way they have been going, because they don't work. I think that's part of the assessment. The assessment shows who does the work and who does not.
T.R. - How did they get the 90 then?
Pat - Well they must have worked. He did, he said he studied. I think he can do really, really well. (October 15, 1997, p. 2)

This exchange later brought to mind a statement made in the Report of the Royal Commission on Learning (1994) suggesting that, "poorly motivated students, of whom our system has more than its fair share, are poor students" (Volume IV, p. 5). I believed that having the students play a larger role in the development of the assessment could revive motivation. Perhaps by increasing self and peer-assessment. The students may have been saying that the mode of instruction needed to be changed. The results showed a problem, and it was a responsibility of both students and the teacher to make changes. I continued to raise this observation. Gradually, acceptance of this opinion was assisted by the receptivity of other group participants. In other
words, Pat went along with it due to peer pressure.

In the previous excerpt, Pat mentions that she will now test every day. I believed this to be a sign that she was searching for solutions. The results, performance and behaviour of students in class were not up to her standards. So, in response, assessment was used to hopefully keep the students attentive and motivated. Pat was unhappy with earlier assessments in which the results were not satisfactory. Pat believed that the students would respond appropriately as she frequently assessed, and that they were just developing, maturing and learning how to learn. I suggested that both the students and the teacher, as they learn about one another, grow, develop and mature together – much like the movie: 'To Sir with Love'. Being able to reflect and critically examine what has happened puts you in touch, provides perspective and inner voice. Our discussions seemed to nurture reflection. During bouts of reflection, less questioning occurred and more telling occurred. Take, for instance, our discussion from October 15th, 1997, in which we explored assessment preparation. I asked:

Were your assessments limited to pen and paper tests?
Pat - Yes, but it was assessing their oral skills in class. We discussed every question in class. I said I want to see if they do anything in class and found they don't, they don't. I know that if we have an oral discussion they're working at less than 50 percent. So it was a good experiment.
T.R. - Not everyone was unsuccessful, several did well.
Pat - Yes and they are the ones that are successful when we do group work, pen and paper, oral discussion; I mean they're going to succeed. They want to. I think that's the biggest key. (p. 4)
Again, the assessment praxes are under critical reflection here as Pat attempts to understand why the results are not what they should be and why motivation is lacking. I attempted to illuminate the argument by reciting what Stiggins (1993) suggested “If you want to appear accountable, test your students. If you want to improve schools, teach teachers how to assess their students. If you want to maximise learning, teach students to assess themselves” (p. 185).

We also discussed Bloom's Taxonomy of Educational Objectives (cognitive domain), which lists synthesis and evaluation as the two highest order thinking skills. It is no wonder that students and teachers struggle to master evaluation and synthesis, which sit atop the higher order thinking skills ladder.

9.3 Autocracy vs. Democracy

Pat mentioned several times that she was in charge and her responsibilities led her to do the things that she considered necessary. Arguably, secondary teachers can be the most powerful people in the lives of youth. They are in a position to impart their values, beliefs and theories behind the classroom doors of our schools. Yet, these same teachers are also being inducted into a profession, starting with preservice. The induction process lasts for many years following hiring, as it may take five or more years to establish themselves in their careers (Saskatchewan Teachers Federation, 1992, p. 8-9). As a result of this induction, praxis is changed. For example, assessment praxes are modified to be less controversial (more traditional). Hence, Pat's
assessments, even though she made them up, were traditional and lacked student input. Induction, then, by its very nature, caused Pat to maintain the old assessment paradigm of efficiency, where assessment was easy to score, quantify and administer. Pat did, however, make attempts to broaden assessment and the curriculum, as this excerpt from December 3rd, 1997, suggests.

Pat - Grade 10 is learning how to learn, not the content, it's more like hands-on science. We're forcing them to do something they don't want to do. I've incorporated more art stuff, creative tasks, the Internet and web. (p. 1)

Pat's contention, that grade 10 is learning how to learn, is clearly an indicator of the new assessment paradigm, where attempts are made to deepen understanding. Her next step would be to involve computer studies teachers to collaboratively plan and implement an interdisciplinary course. By placing certain technological demands on the students, the course could then be identified as contemporary. The Ministry of Education and Training (1997d) suggests " new partnerships should be encouraged among subject disciplines. New interdisciplinary courses, which contribute credits towards both disciplines involved, should be developed " (p. 8). Pat seemed to want to have a mix of tradition and newness in her assessment praxes.

Traditional assessment and instruction is often linked to a traditional self-centred teaching that operates in isolation (individualism). Students can sometimes respond to this style of teaching with feelings of alienation, and
withdraw from the unpleasant, unrewarding relationships (Hargreaves & Fullan, 1998). By reducing individualism and making the program more outcomes-based, students can have more opportunities to exhibit their abilities, thereby producing more equitable assessments. Assessing the extent to which teachers are succeeding in their move towards this 'new' assessment paradigm requires teachers to examine specific questions. For example:

T.R. Can anyone make a valid judgement of teachers unless they take the time to know what is going on in the classrooms? How can you assess unless you spend time with that person? Are students then in the best position to assess their teacher?
Pat - But they lack the knowledge. We are after knowledge, to instil knowledge, social skills, academics, and practical skills. (December, 3rd, 1997, p. 3)

Pat had many thoughts concerning assessment as an underlying foundation of any good curriculum. She was assessing in a teacher-centred mode yet she attempted, when possible, to empower students via student-centred assessment.

**Assessment Modes: Empowerment**

Pat had tried to empower students by giving them more choice. However, the attempts were not up to her own standards of success and, predictably, some of the blame for this was laid on the shoulders of the students. Pat explained:

By the end of the course, if you ask them to do peer-assessment, they look at you with blank faces because they don't do it in elementary. They don't understand the concept of assessing themselves. There are practical skills, either you cut it right or you don't. Also, social skills, oral
competency. But it's academia that we are after. (December, 3rd, 1997, p. 3)

Pat viewed assessment abilities in students as something that could be nurtured. Yet, it had to begin in the early years. We discussed this belief and it was noted that it is most likely that peer and self-assessment modes are being taught and used in the elementary classrooms. I added that this is what I have seen in the elementary schools I have visited and taught in. Even though Pat's observations were acknowledged, these suggested student shortcomings were not accepted as fact. The transformation of student perspective can be facilitated through a sharing of tasks such as assessment. Pat's ability to articulate her thoughts and feelings were key to her professional learning.

9.4 Assessment: The First Year

For most first year teachers, 'survival' is the major priority (Fullan, 1991, Rosaen & Schram, 1997) and, in the bustle of school, efficiency is often key to survival. Pat wrote:

My job offer came as a bit of surprise since it was getting so close to the beginning of the school year. I only found out what I would teach two weeks before school began. I was in a bit of a panic but with some help from Bob and Jan I am managing. It is nice to see and do what was done in previous years. I plan to add my touches here and there but only when the time is right. (October 19th, 1997, p.13)

Pat’s extensive use of traditional content-based assessment methods (fill-ins, multiple choice, short answer, essay)(Appendix P), can be seen as a search for
efficiency. Pat was a caring teacher who 'was doing what worked,' her approach was authoritative and promoted competition in order to control students because she viewed control as the major issue in school, as do most first year teachers (Schoonmaker, 1998, p. 562; Wideen et al. 1998). This encapsulation of Pat’s practice partially answers the research question: What were participants' initial understandings of assessment and actual practices at the onset of this research?

Pat had many reasons for assessing in this manner, one of which was the fact that there was no opportunity for inservice professional development. With slashed budgets, increased class sizes and political turmoil (Bill 160) distracting most educators from the usual tasks, we have put many educators, especially first year teachers, into survival mode. We also must keep in mind that the narrow in-servicing of teachers, without taking into account the total teacher, in terms of age, gender and personal values (Fullan, 1991), creates problems rather than resolving them. Pat had complained about the quality of the preservice and was not receiving inservice professional development. She wanted a simple answer to our problem under consideration: How can teachers include and conduct credible peer and self-assessment? She wanted something already made that she could copy and use. Pat didn't think she had the time, or expertise to develop, or critically reflect on, new assessment tools. Reflectivity is something that requires time to develop. Many believe it is a skill that develops gradually, over the course of a career (Schoonmaker, 1998).
In sum, a teacher is a person who learns from their students and vice-versa. Learning on the job cannot be controlled, it is happening all the time. However, it can be documented and the data used to enhance learning. Indeed, reflective habits need to be nurtured, whether teachers are in their first year or their twentieth year of teaching. Normally, a first year teacher has so little time to reflect that it seems incumbent of educational authorities to provide all beginning teachers with reflective partners, mentors and supporters, who can assist in the process of adaptation and acculturation, and create opportunities (time) for first year teachers to reflect. It could be that the need for autocracy and individualism in all teachers is really an attempt to slow down, not only the first year, but all years. Once slowed down, teaching is easier to comprehend and the educational process is easier to reflect on. This slowing down allows "... teachers [to] make more intelligent decisions about strategies " (Schoonmaker, 1998, p. 567). In the absence of critical reflection and collaborative development, traditional methods of assessment and teaching can take over. What this means for Pat is that her transformation is curtailed and diminished because she is busy establishing her initial practices and asking fundamental questions related to teacher identity. Until this is complete, change or higher level reflection cannot really be entertained. In short, you need to find out who you are first!
9.5 Tensions

From the onset of this study Pat made it clear that this was her first year of teaching and she was stretched by the demands of the job. She noted this in her journal on day one: "I have maximum activity in a minimum of time and this is a huge load for any beginning teacher" (October 9th, p. 1). Combine this 'load' with a faculty of education experience that was wanting, and I began to see her source of tension. These findings are in no way unique. In a review of 'learning to teach' studies, Wideen et al. (1998) point out that first year teachers were often,

... struggling for control, and we heard words of frustration, anger, and bewilderment. In their view, their university experiences were not equipping them to take charge at this crucial point in their emerging careers. In such contexts, beginning teachers aimed to survive rather than learn from experience. (p. 159)

Pat's reflections and actions in our study can be interpreted in the light of these findings, leading to a better understand of her comments. This is but one of the possible lenses at our disposal. Schoonmaker (1998) suggests:

"Teacher preparation is a launching " (p. 588). As Pat 'set sail' in our study she felt uncertain, unprepared; she wanted more support, guidance and resources. She was looking for answers, a handout, an assessment tool, something concrete. Instead, we supplied more theory and reflection upon practice, at first. This frustrated Pat, who was in search of the products of
theory and practice in order to take charge of her life and classroom. Pat remarked:

Well how can you make a stomach? We're doing heat with the grade 10's — give me something to work with and I'll work with it — I don't have the time — give me the plan — but how can you assess if they plant a garden? They are only here 76 minutes a day. (March 4th, 1998, p 2)

The tension in Pat's words indicate the extent of her needs and anxieties. Much of this need may have come about because she had brought with her the expertise and insight developed from the perspective of a student (Schoonmaker, 1998), and yet now she realised that this was not enough. Her needs were greater, as her responsibilities were greater. She was feeling stretched in all directions. This left her feeling confused as each dilemma presented itself. Her beliefs from the past were being challenged; her views of teaching were evolving and growing in response to her immediate experiences and reflections on the job. Her identity was changing, and the Board wanted her, and other first year teachers, as a matter of policy, to observe other classes. Pat reflected:

I make arrangements to go in, maybe it's just a special thing for me, they said I can make arrangements to go in for 5 days or 5 periods. T.R. is that for everyone in the department? Pat - I don't think so, I just know about me. Well I think others who have moved up from elementary have this privilege. T.R. Have you used this opportunity? Pat - Not yet, they just got it through after Christmas — it was OK'd — however, it is additional work for me since it is in addition to teaching my classes. T.R. So when you go into the classes do you assess and what are you looking for?
Pat - I sat and worked in other people's classes doing my own work, I observe a lot of things in their classes, techniques, I mean I don't officially walk in and say I'm here to watch you. I just go in and work on computers during computer classes and Bob. I worked on the science computer while he worked on physics. (March 4th, 1998, p 1)

Although Pat was unclear about the goal of her visits, this experience allowed her to see the classroom from another perspective. She was a teacher observing another teacher teaching. Pat can now pose her questions in an effort to reflect on the social and educational realities she sees. Pat brought many questions to our supportive group. However, her questions often were difficult to address. For example, Pat asked:

I wonder, should we ask them [students] what question they want on a test, because we are giving them the authority to have input — If they want: who, what, where, when; then we override their suggestions. We are still doing what you don't want us to do, making it for them. Am I right? (February 18th, 1998, p. 2)

Pat wanted simple directions; however, our group often supplied only opportunities for self-understanding and self-direction. She needed to make some decisions based on the theory discussed and the practices she has viewed as a teacher and as a group participant. The conflict between teaching as she had known it and teaching as she now knew it, was a source of tension for Pat. Pat persevered, as she was an educator who was eager to meet whatever challenges lay ahead. You could say she moved towards a creative tension, as it made her uneasy, yet challenged and stimulated her. For example, at any time, this research could have caused many participants to
drop out of further involvement. Instead, Pat, a first year teacher, jumped into this project with little concern for problems, it seemed, as she focused on the benefits of such an effort all year. Pat wrote:

I have a lot of experience in different areas and the thought of getting involved in more reflection, since I didn't like it in the Fac. of Ed., makes me think it will be different this time since teachers are doing it and not people who want/might be teachers. (October 8th, 1997, p 1)

Pat added:

After months of talking and teaching I think it's time for some kind of a break. It has been a tough year but we've pulled together and I feel we are better for it. I just hope I'll have a job next year with Bill 160 and enrolment. Anyway, I'll use what I have learned and it will help. (April 10th, 1998, p. 43)

Pat had a positive outlook; she was optimistic about the past year in spite of the strike, and being hired late in August, saddled with grade nine and ten classes, coaching and being involved in this study. Each one of these events was stressful but a sense of humour and purpose enabled her to cope and to make significant progress. For instance, Pat's casual tone concerning collaboration on the job:

T.R. Have you spent time in Jan's class? Pat - I just wandered through a couple of times -- but it depends whose there on my prep. I spent some time in Bob's, very unofficial. T.R. Do you exchange resources? Pat - If you need it, you get it. I have stuff from B.M. and others -- or you find it yourself. I'm very independent. If I need it I go and find the answer. I don't like it forced on me. I don't like it because it's not my style. (March, 4th, 1998, p. 1)
Pat could have been quite defensive, anxious and cold when I asked about her awareness of activities in other teachers’ classes. Instead, she was calm and matter-of-fact about her efforts to view other classes. Pat was able to reflect effortlessly and openly because she did not prescribe to the old adage that ‘there is no substitute for experience’. She noted that what she brought with her to the classroom was a great deal of experience from other activities. Pat made it clear that she could see several options for her in any given situation and she usually chose one that supported her goals and beliefs. She added:

I have to plan to make changes to assessment for next year but I don’t know what I’m teaching yet. If I begin with student input that means I will have to wait until the beginning of the next year. I think I should continue to mark [assess] the way I did this year and slowly work in more of the hands-on student marking [tools] we did this year. (Journal, April 2nd, 1998, 39)

Pat was a confident, informed and genuine communicator who believed any conflict could be dealt with in a positive manner. This is one of the many images I had of her during our study. Consider this excerpt:

T.R. Does recognition need to be more formal? Is it necessary? Pat - You don’t need the pat on the back. If you are doing your job that is all you need -- we need to strive for competency -- not a pat on the back -- I have a built feeling about how I’m doing -- keeping up to date is intrinsic -- you don’t need someone there saying you’re doing a great job. It makes me angry to have someone tell me I’m doing a good job when they are not any more advanced than I am. They have no background, a Principal or Vice-Principal who have no idea how you teach or what you teach and they are telling you, you’re doing a great job. What do you mean? (March 4th, 1998, p 2)
Perhaps this is an instance of inexperience; Pat was viewing this as she would as a student. Most teachers are aware that an administrator could have been a science teacher, science department head or science consultant before entering administration. Also, many administrators do undertake additional training in teacher assessment, so the notion that administration has nothing to offer a teacher is shallow at best and was a source of tension between us, since I do not share the same belief. Often Pat's stance in class was authoritarian, yet she addressed it as a form of independence (individualism). These contradictory images of Pat, a first year teacher, in this study have been noted in other studies of first year teachers (Schoonmaker 1998; Wideen et al., 1998). It is as if preservice students enter the profession with their minds made up, only to realise how much more there is to teaching.

9.6 Assessment Praxes: Perspective Transformation

The third research question asks: To what extent did these initial understandings and actual practices change due to the illumination of assessment praxes? For Pat, our efforts to examine act and reflect caused her, over the course of eight months, to behave in a manner that demonstrated a change in philosophy. She began our study, I believed, in a defensive mode. I saw it more as an issue of trust. Yet, as time passed she began to see our efforts as a 'bottom-up' rather than a 'top-down' approach to the development of assessment praxes. And by the end of the project, she seemed to be quite
proactive and open. Her transformation may have been due to our cultivation of an atmosphere of mutual respect and tolerance of others' views (Elliott, 1991). For example, by April 3rd (1998), Pat reflected:

Getting together with other teachers has been something I usually do after hours. It was a time to relax. I find I am more able to do the same during school because our group lets me do this. I can lean on Jan or someone else while I get rid of my feelings, it's like being married and I'm not yet, but I guess I'm right. In the future I'll try to do more of this, it's been helpful. (p. 40)

From the onset of our study, Pat made it clear that although she was in her first year of teaching and had a basic understanding and appreciation of assessment, she wanted more. Pat understood that our discussions and interactions would impact her perspective and on-going transformation during this study. Our attention came in many forms. For instance, on several occasions I watched her in the classroom while she made changes in her praxes. My attention was general, yet I did have a specific concern, assessment. Pat did not always assess when I visited, hence my observations could be labelled 'general' (Hopkins, 1993), on some occasions. I followed some good advice as I was careful not to move too quickly to judge; I used my interpersonal skills when 'invading another person's space', and I tried to follow my aide-memoire (Hopkins, 1993). On December 10th (1997) I visited Pat's class and came away with these impressions.

I was the first person in the class, which was the same one used by Cal, Bob and Jan. As the students began to enter the room I noted the different types of clothing and where each one sat. It was funny,
how girls tended to sit with girls and boys with boys, yet it was grade 10. Everyone came prepared to work but as soon as Pat stepped into the room everyone seemed to increase their level of activity, becoming more active and louder. Pat started to talk to various students about different issues such as work not done and poor grades, absences, and work without a name. I saw some students start to cross that behavioural line. I felt my own brow start to furrow. Pat turned, looked at the offenders, and made a quick comment about grades and turned back to the blackboard. The three students did become quiet, but as I was unaware of their past, I don't think I understood exactly what was going on. Pat handed out a worksheet and assigned text pages to read for homework. The remaining time was spent working from overheads (copied the ecosphere drawing). The class in general seemed to settle once the tasks were assigned and I left with a good impression of the period. Pat had only a few minutes before the next class so I told her we would talk later. (p. 33)

Following the advice of Hopkins (1993), I gave Pat her feedback within 24 hours, using facts, and welcomed a two-way discussion. After this class observation Pat suggested that this was her good class and they seemed to handle most tasks well. Later in the term, in this same class, she would experiment with more student assessment input. The decision to use this class was, in part, due to her perception that this class was easy to control. I knew what she meant, since I had visited her other two classes and seen that they were behaviourally more challenging. In her 'good' class, I think she appreciated the respect they showed her. They responded well to her behavioural prompts and cues. While in our group, Pat listened carefully and brought forward timely insights as we voiced our individual "... ways of looking at and thinking about events and interactions of the classroom as a basis for improvement" (Rudduck, 1991, p.18). For instance, Pat added:
Assessment -- Well we have two choices, either go back to what we were doing or come up with applications to replace past practices. (March 4th, 1998, p.3)

Pat's straightforward approach was refreshing and to some extent a beacon for our group. She was eager to change (to engage in action) and mentioned that if someone would “give her the tools” she would “run with it”. Pat felt she needed to have someone else provide the assessment tools. I understood this stance to mean that until this happened, little, if any, change was possible. For Pat, being able to find that ‘time’ to change assessment praxis tended to dictate what was possible and what was not. A lack of time meant her tests were like those of her colleagues, mostly content-based, traditional, and narrow (Appendix P). Yet upon closer examination, Pat's assessment praxes were a curious mix of tradition and alternative modes. On February 4th, 1998, I asked her about her assessment activities.

What assessment means are you using in the second term that are new or refashioned from the first term?
Pat - Well the way they work, independently, is not good. So, I'm setting up more group work, seminars, and I have them making web pages that are much more interactive. Because, that's what they want to do, so, that's what I want to do.
T.R. To what extent will peer or self-assessment play a role?
Pat - About the same as first term, but they are more involved.

She explained that she thought her use of many modes, such as peer-assessment and the ‘web’ (Internet), allowed students more opportunity to demonstrate achievement through involvement. This effort to involve students in assessment demonstrates a change in values, compared to a point early in
our study, where Pat mentioned that most students were incapable of completing these types of assessment. As a group we agreed with Pat’s initial position, yet the group movement was towards these alternative and varied assessment modes, which indicated to me a shift in preconceptions. Pat noted early in our study:

> I use a lot of different methods and I don’t have time to make my own assessments, so I need to borrow and beg from others. This is, after all, my first year and I’m just organising. (Journal, October 15, 1997, p. 3)

Pat was, in the early stages of our study, establishing standards and sorting out targets. This pursuit of self-awareness meant a movement from decisions based on theory to critical descriptions of practice. Her practice now became a place to theorise. Part of that development included her realisation that students could complete more self and peer-assessments. I noted this in my journal on October 17, 1997:

> Pat is really working at getting all the information she can quickly in order to get ahead. However, I did this too when I started teaching and discovered years later that teaching can never be mastered. Every day is a new challenge and a chance to add to our resource base. Change happens to you when you are least aware of it. It could be a decision to question differently or apply resources differently that reflects a shift in beliefs. (p. 6)

Pat always wanted to be viewed as the participant who was either already doing what we discussed or had already done it in her class. Eventually, she let us see another side of her – in which she admitted that she, too, needed to collaborate with others more often and involve the students to a greater degree.
in assessment efforts. Pat added:

I am just saying that if you need it you get it, I have stuff from Bob and others — Or you find it yourself. I need to get a lot more information on assessment but I like to do this informally. It gets pretty sticky if it's formal. It's the same with the students. If you work with them informally then you get a lot more done. (March 4th, 1998, p. 1)

This sentiment contrasts with statements made by Pat earlier in our study, which were less open and more protective. Pat's transformation was mostly interpersonal, as she seemed to trust our group more as the relationship aged. Professionally, Pat became more collegial. Near the end of our study, March 4th (1998), I asked Pat about her readiness to share

T.R. Do you exchange resources?
Pat - I have stuff from Bob and others. I'm very independent, if I need it I go and find the answer. I don't like it forced on me. I don't like it because it's not my style.
T.R. What do you mean forced?
Pat - I am just saying, when someone says you have to do it this way or this person will help you, well, you may not be able to work with that person. I'd rather have it informal, rather than formal. Things that get official, get sticky. I get more work done unofficially, and, I'll go get assessment tools. If I have a question, and I want an answer, this is who I'll go talk to.

I hoped that our individual and group discussions had caused her actions (change). However, it could be that even our mere presence (peer-pressure) was the cause of her growth. Anyway, during another visit to her class I noted several changes,

Pat was busy setting up a lab (limewater test for carbon dioxide) for her grade nine advanced class when I walked in room 123. I helped
her make sure all the groups had the right materials. The task within
the lab was to observe chemical change using commonly available
substances. A few minutes later several students came in to help.
These were her assessors from her grade 11 class. Pat gave them
clipboards with pencils and asked them to note who did what. Great,
I thought, Pat is delegating and empowering. I asked if these
assessors were being graded and Pat said: "no, next time". As the
students arrived they seemed very serious (test faces) yet, Pat was
quick to explain and show (exemplars) in great detail that they would
have several chances to do well. I noted that this seemed to be
evidence of an outcomes-based program and not content-based. I
was happy for Pat as she moved around the room making
suggestions and reminding assessors to help out. The 70 odd
minutes flew by even for me and as the buzzer sounded, indicating
the end of the period some students seemed frustrated that the
period was so short. Pat remarked ‘you couldn’t please them all’.
(March 25th, 1998, p. 47)

Pat was, for this class anyway, more of a facilitator then in her usual practice.
Pat was looking for students who could not only apply skills but also explain it
to an assessor. It was very open-ended and each student had opportunities to
demonstrate an outcome. I believe our efforts helped Pat validate her
perspectives and solve problems that faced her. Pat explained in her journal,

   Listening to other teachers complain is good. It lets me know that I’m
feeling the same as others and this gives me a boost that I can run
with for days. Meeting is a source of power; a refuelling that gets me
over the next hump. (March 12th, 1998, p. 39)

In sum, our experiences led to a collegial mode of communication from one
that was less so. Our group’s ability to mesh allowed the examination of
beliefs and dilemmas concerning assessment praxes and eventually led to
the use of alternative and varied assessment tools. Sometimes our actions
remained theoretical and other times they became part of a practice. If the
research had continued we would have been able to more fully put into practice
the modes we discussed and reviewed. Admittedly, we did not overcome
the " constraints of overload, isolation, and compartmentalization that are endemic
to schools " (Earl and Cousins, 1995, p. 42). To do so, entails fundamental
change at the system level.
Chapter 10

Illumination and Transformation

This study attempted to answer two sets of research questions. The first set involved the nature of assessment:

1. What was the current state of assessment practice in secondary science?
2. What were participants' initial understandings of assessment and actual practices at the onset of this research?
3. To what extent did these initial understandings and actual practices change due to the illumination of assessment praxes through action research involvement?
4. What was their level of awareness of current Ontario government pronouncements and in what ways did they implement this knowledge?

As we dealt with assessment related questions, a second set of questions, linked to the action research mode were addressed, as I asked:

5. What did participants learn about action research?
6. What other learning and professional gains were realised during this study?
7. What did I learn about action research and assessment through my involvement in this study?

Questions 1 through 5 will be answered in this chapter, while questions 6 and 7 are addressed in chapter 11. To answer these first five questions it was necessary to illuminate assessment praxes by asking what is being done, why
it is being done, how it is being done and who is doing it in these secondary science classrooms? Initial assessment understandings were discussed, examined, recorded and reported, as was each participant’s transformation throughout this inquiry.

10.1 Illumination: Learning about Assessment Praxis

This study involved several substantive acts and a research mode that was disciplined and personal (Hopkins, 1993). Participants worked to improve and reform their praxes by illumination that was realised via recursive cycles of reflection, discussion and action. We recorded these activities and examined the transcripts. We gathered evidence in journals and pooled assessment tools in order to grow and change. From the onset I addressed the first question, which asked: 'what was the current state of assessment in these Ontario secondary science classrooms?' In response to this query, a general ‘group observation’ is provided, together with more specific insights. This chapter contains evidence of our growing understanding and transformation efforts in relation to why (function), what and how (form) participants assessed.

Generally, it was discovered that each participant’s current state of assessment praxis was quite traditional (form). It was teacher controlled and content driven (subject-matter based), and utilised fixed testing events (unit quiz, unit lab, mid-term, final exam). When teaching, each participant acted as a transmitter of specialised information. The learner was encouraged to acquire a fixed body of
knowledge in the same form as the teacher delivered it. Each teacher used a narrow source of materials (textbook, lab book) and followed a predetermined course of study (using dated guidelines) in order to realise exit criteria (final percentages). Exit criteria were realised primarily through paper and pencil modes of assessment with little actual performance based assessments. Participants viewed and addressed assessment largely as an afterthought. The planning (content coverage of text) and teaching aspects were seen as instruction issues that preceded any concern for assessment. It was strictly plan, teach and assess, with little attempt to plan varied assessments ahead of the lesson. The domain assessed was primarily knowledge recall via short answer, fill-ins, true/false and multiple choice tasks, as is typical in most content-based programs.

Why Assess?

Why assess? First, each participant indicated that assessment was a legal obligation tied to the Ontario Education Act, which was interpreted and applied via the Board (employer), school administration and, finally, the Science Department Head. Second, each participant explained that they had to produce a score for each student that could be transferred to a report card that eventually found its way into student records (Ontario Student Record-OSR) and the hands of parents, guardians or immediate caregivers of students. Third, participants used assessment as a consequential process that could either motivate students to behave or cause students to work more intensely to
achieve desired expectations.

Other reasons for assessment (function) included the need to monitor student progress (counselling), as detailed in Pat's journal of January 11th, 1998.

Some students say they understand but I think they are just saying this to protect their feelings and I know by their marks how much they understand. If someone is slipping I meet with him or her after school and talk about how they can improve. This is something you have to do with no other students around. Sometimes it works and other times I just don't know how to help them. (p. 43)

Also assessment helps to ascertain learning needs (Special Education), as Bob's journal entry suggests:

I have an OAC student, who is failing, not because he isn't a good student, it's because of his abilities in math. If you are weak in math it will show up in physics class at some point. He is getting extra help from a peer now. I set this up and he should be OK. (February 4th, 1998, p. 22)

Assessment was used for grouping and/or selection (Honour Roll, extra study group). Often participants, in isolation, used random assessment as evaluative tools, to inform curricular change. Jan used assessment to check for understanding and indirectly to check to see if her methods were achieving the desired outcomes.

I like pencil and paper tests. For me, anyway, I feel it is the best way I can get a handle on whether the students understood the material or not. I like the factual tests, I guess, but yet I try to instil some practical applications so that it is not just rote memory. That way it will simply prove that they have truly understood the
material and not just memorised words on a piece of paper. 
(October 8th, 1997, p.1)

Assessment provided feedback for students, parents and the educational system (reports cards). It was argued that assessment prepared students for life (ability to accept criticism) after High School. For instance, Bob was preparing students for University by assessing in the same manner as a University:

Bob - Exactly, so I mean, I know in University there's a weekly quiz, lab, assignments and they're going to have tests of the format that I'm using. So, I mean, I don't want to stray too much because I want to give them as good a preparation as possible. (October 15th, 1997, p. 4)

Assessment, it was claimed, helped maintain standards and assisted in making comparative analyses of students and classes. As noted in the case studies, assessment was largely traditional at the onset of the action research, due to a lack of time to do otherwise, isolation and/or the deliberate pursuit of individualism (self-reliance). Reasons for this conservatism could also be found in the low levels of participant assessment literacy (awareness of current forms/usage) and professional development at either the preservice or inservice stages.

What to Assess?

How did participants know 'what' to assess? Participants followed the 10 year-old Ontario Science guidelines. This meant that their assessments were
aimed primarily at knowledge criteria, as measured via weekly tests, midterms and a lengthy final examination (Appendix Q). Yet, in 1997, the emphasis, direction and orientation of contemporary assessment in science aimed at measuring scientific literacy: "the acquisition of science knowledge, skills, and attitudes needed to function and contribute successfully in the world" (Ministry of Education and Training, 1997d, p. 3). Bob, the Science Department Head, spoke to this issue many times. On October 8th, 1997, the following conversation took place:

Bob - We all have assessment schemes that are dictated by the Ministry of Education from 1988. There is a chart that each teacher in the science department would have and it gives you a range of where your assessment tools have to fit. So you may have a responsibility range of 0-5 percent, an exam range of 30-40 percent, and a test range of 30 to 40 percent, you know, as well, something like that.
T.R. - Do you follow 1988 Ministry guidelines?
Bob - Yes, I'm in that bracket somewhere in my range. I may be at a maximum in one range and minimum in the other, but I'm within the ranges and try to make sure everyone in the department is in those guidelines. (p. 3)

In examining participants' various assessment tools, we see that the acquisition of scientific knowledge takes precedence. For example, processes (observation/deduction - Appendix K), explain principles (heat transfer), tell about a scientist (Bohr - Appendix M), comment on science in our society (convection - Appendix P) and explain some aspect of ecology (pollution). While these activities may be credible means to measure some degree of scientific literacy (Ministry of Education and Training 1997d), there was a great deal more that needed to be done. More assessment of actual skills
(psychomotor domain), attitudes (affective domain) and attention to the Pan-Canadian Science-Technology-Society-Environment (STSE) documents was necessary.

The expert panel examining secondary science in Ontario for the Ministry of Education and Training (1997d) reported:

The present science curriculum covers a wide range of content in terms of both the courses available and the topics included within the various courses. Students get good exposure to general and specific knowledge and skills and develop good verbal and debating skills. Most of them acquire a solid foundation of knowledge. The content of the curriculum is activity-based and recognises the importance of process. In addition, it allows creative and individualised approaches and encourages a variety of assessment techniques. (p. 8)

In the practices observed in this study, any activity-based experiences were infrequent labs that were simplified by teachers and easily accomplished by students via the handing in of a written report. There was little time for teacher demonstrations and usually only one lab in each unit of study.

An observation similar to the Ministry of Education's led the expert panel to suggest that "the implementation of the current science curriculum presents a number of problems that are demonstrated by the performance on external student assessments" (Ministry of Education and Training, 1997d, p. 9). These weaknesses are as follows:

Some students have limited ability to gather and evaluate
information from a variety of resources. They have difficulty reading effectively, understanding what they read, and communicating orally and in writing. They often lack the ability to think critically, evaluate data . . . Many have poor problem-solving skills and cannot identify solutions . . . [they] are not sufficiently self-motivated, independent, and active learners. Students also showed inconsistencies in knowledge, skills . . . [and] this may be a result of inconsistencies in standards and evaluation, teaching, implementation strategies, and contextual relevance and application. There is . . . overemphasis on content . . . memorisation, a focus on examinations, and poor retention over time. (1997c, p. 9)

There may be a number of possible rationales for the above statement. For instance, the inability of some students to absorb such a vast amount of information during a semester, especially in view of questionable levels of reading comprehension, reduces problem-solving success. As a result, most assessments in our study were altered to accommodate lower level (knowledge) thinking targets and lab skills were given less consideration (Appendix M). Other concerns were also voiced in our study. For instance Pat explained:

I think they have a lot of work right now and they’re not used to it. Actually, I think they are good students, but they’re just a little frustrated right now. They have so much work to do, because there’s a big difference between grade 9 and 10. They don’t have the work habits. (October 15, 1997, p. 2)

Another problem that participants voiced was a concern about the breadth of the course versus the allotted time each semester. Pat, a first year teacher, addressed the issue of time in her journal (October 28th, 1997):
As a new teacher I am expected to coach. I am expected to get involved with the students and prepare three courses (two, 9 biology, and a 11 biology) per day. I mark the work, do counselling and there is too much theory to fit in so I'm going to skim a few parts and try to cover everything to some extent. No wonder we are going to strike. (p. 14)

Overload caused labs to became infrequent. Labs required more preparation and completion time, and not less. Participants also suggested that reading comprehension skills, problem-solving abilities, critical thinking skills and motivational problems were obstacles in the planning of more labs. A once-a-year event, the Science Olympics (Appendix L), allowed participants to assess higher-order thinking skills and consider both the capacities of students to engage successfully in a complex process and develop a product. This once-a-year event came closest to what is suggested in the proposed contemporary assessment-driven science curriculum being espoused by the 1997 - 1998 expert panel examining secondary science in Ontario.

How did Participants Assess?

In general, participants in this study used a teach, test, teach routine that required frequent traditional means of assessment (Appendices K, M, O, P), including many forms of true/false, matching, completion, short answer, multiple choice and the odd essay question. As previously mentioned, these means of assessment were efficient, yet were limited to content knowledge targets and narrow (lower order) thinking skills. Often, they merely required students to
identify and factually recall a correct answer, rather than produce one.

In their assessment praxes, participants suggested that they followed the department guidelines (Appendix M), which were interpretations of Ministry guidelines. These department guidelines were then communicated to students.

For instance, Jan told me that "she gave out these guidelines at the beginning of the semester. The guidelines include divisions for labs, assignments, tests, exams and independent study " (January 7th, 1998, p. 3). All participants followed this custom of handing out guidelines during the first week of school in order to communicate assessment expectations and policy. The handout placed an overwhelming emphasis, 75% to 80%, on written recall assessed by means of quizzes, tests, examinations and independent study, and only 20% to 25% on labs/assignments. Within the independent study, only 4% of the 10% were allotted to any application of science during the once-a-year Science Olympics (for examples of tests, quizzes & Olympics see Appendices K,L,M,O,P). Although these percentages did vary from grade to grade, it was usually weighted towards more written products requiring memorisation, with very little emphasis on higher order thinking skills such as evaluation, synthesis, analysis or application. This emphasis on mostly traditional modes of written assessment, which was largely teacher-centred, resulted in a curricular arrangement that had little if any connection to real-life issues and did not address science-technology-society (STS) education issues.
Therefore, assessment irrelevance and monotony challenged student interest and motivation. Cal also spoke to the issue of test frequency on October 8th, 1997:

I test on a weekly basis and I think it’s important for those general students to know exactly how they are doing, cause that’s important to them. And if they don't get regular feedback they do less and less work as the year goes on. (p. 1)

Cal viewed this assessment practice as a means to motivate and sustain attention.

Students had no autonomy or voice concerning how they were assessed or what made up the assessment. On several occasions I spoke to this issue of student input. For example, I asked Jan (January 7th, 1998): " Did the students have any input into the construction of the exam or contribute questions? " Jan’s reply was simple " No ". The issue had never been considered, so students did not have a chance to choose a problem of interest to them or select a method. Nor were they allowed to offer evidence (i.e., STS perspectives) that came from outside the expected modes of assessment. The curriculum was passed to them via dated textbooks (5+years old), published labs and each teacher’s verbal explanations.

How did Participants Interpret Data?

How did participants interpret student data? Again this was directed by the dated Ontario Science guidelines, with units given equal weighting in order to
reach a score that represented a total out of 100. A student who memorised the content could achieve a high score. Little attention was paid to the application of skills in the psychomotor domain or the affective domain. Bob, the science department Head, explains his use of data this way:

During the semester, I find inevitably if I was asked by a teacher or parent or by that student, how they are doing in the class, I think I fall back to their marks. I find it very difficult to get beyond the marks to determine what their understanding level is in the course. (October 8th, 1997, p. 3)

The number or grade attached to an assessment was the only evidence given consideration at the end of the course. Both the department and the administration used the number to suggest a level of student achievement and performance. There was no consideration of qualitative data unless a student scored in the high 40's and promotion was considered in spite of the grade deficit. For the sake of efficiency, I was told, this was the best way to assess. There was no time to consider a portfolio or other qualitative data for all students. The grade (percentage or letter) was something tangible in a subject area where scientific literacy today means "... the acquisition of science knowledge, skills, and attitudes needed to function and contribute successfully in the world " (The Ontario Ministry of Education and Training, 1997d, p. 3). Clearly participants in this study aimed at knowledge acquisition more than skills or attitudes, and participants invested a great deal of energy attempting to measure it. All participants suggested knowledge was easier to assess.

Assessment results could then be used to compare one class to another during
informal discussions. However, there was never a formal attempt to use norm referencing (defined group comparisons) in our study.

For many years in Ontario secondary education a passing grade criterion was used as a focus. This focus or target was prominent on formative and summative assessments. Each assessment event had a dividing line of 50% that each student needed to surpass in order to be deemed successful. Less than 50% meant a student had failed to achieve a pass on a particular task, term or course. Again, an outcome of 50% was viewed as a minimal standard for passing the test, term or course. Each class could then be compared to this grade criterion. For instance, we talked about how many failed, or would fail, in each class, based on their ability to score 50%. We discussed how many students were achieving at a certain level by talking about assessment scores. This criterion (outcome) was the pass/fail line. The percentage could indicate a summative score (target) by combining all assessment results for a term or course or it could be a formative score indicating the level of performance on an individual measure. So, if a student scored below 50 throughout a term then they would probably fail the course and not receive a secondary school 'credit'. However, it is possible, mathematically, to get less than 50 for several tests and score more than 50% on others and receive a passing grade for the course.

Another means of referencing was to use a student's results to illuminate patterns over a period of time. This self-referencing was used to examine an
individual's series of scores to determine if there might be a need to intervene (failing, special education). Overall, student data consisted of numbers on a page. The number 50, the pass/fail line was an important criteria. It suggested that a student understood at least half of the content delivered. These criteria, although narrow and crude, underlined the need for ease of assessment. Jan emphasised this need by pointing out a desire for tangibility, suggesting "it's concrete for me. One thing I might do is boost a grade 3 percent: say . . . 47 to a 50, if they earned it" (January 7th, 1998, p. 3). Jan's inclination to boost a grade comes from her understanding of 47 as a failure and the loss of a student's credit, whereas a grade of 50 would be a pass and an earned credit for a student. Jan would then be relying on her subjective judgement of a student's effort throughout the course.

The recording of student scores (data) by each participant was a consistent entry out of 10, with a cumulative exit total of 100 at the end of a course. The only exception to this would be the weighting -- for instance, a final exam of 30%, labs 15% and tests/quizzes 35% (Appendix N). Results were returned to students following an assessment and a progress report would be issued at the mid-term and the end of a semester (final report card). Parents became involved in the assessment process during interviews following the mid-term report. Evidence for the grade was most often a series of scores that would be discussed and examined with parents. As well, usually at the end of term, staff would attend promotion meetings to review the progress of students and
compare notes across subject disciplines to see which students needed
counselling, special education help or were to be considered for the Honour
roll.

Overall, the development, treatment and review of student data were not ideal
and it wasn't going to get better in the eyes of participants. Each participant
voiced concerns about impending changes (Bill 160) to the Ontario secondary
school system. These changes would require teachers to teach more classes
than they do now, and each class would have a higher number of students.
There would be less time for preparation and even less opportunity for
inservice. In our study, teachers were already finding it difficult; so, with even
more demands on their time and abilities the situation may become
overwhelming. Therefore, the tasks related to the improvement of assessment
were even more problematic. Further, Cal explained in his journal that:

It is easy to stay with what works now. It may not be the best but
every other way will have problems too. To change, it has to
happen during the summer. I can't teach more with less 'prep',
bigger classes and a new curriculum being pushed on us.
Teachers at our school are being pushed into a new world that
has not been studied very well. We haven't got the training.
Sure, I can do it, as long as no one expects too much. Our way
of testing works now and I'd like to do less well than more badly.
(Journal, December 12, 1997, p. 5)

Cal speaks to many issues here. How he assesses may be imperfect but most
assessment seems to have strengths and weaknesses. Hopefully, we can
minimise weaknesses and maximise strengths through deployment of a range
of assessment methods.

Assessment Literacy and Professional Development

In response to the second question, 'What were participants' initial understandings of assessment and actual practices at the onset of this research?', it seems that some assessment knowledge (literacy) was missing. Knowledge concerning terms and words currently used in assessment such as exemplar, exit outcome and performance assessment was either unfamiliar to participants or misunderstood. Mostly, teachers in this study relied on tacit knowledge and implicit processes. Earl and Cousins (1995) explain:

Teachers' [Participant's] tacit knowledge of their students and their subjects were sufficiently well honed to allow them to fulfil the expectation of the times. Teachers could operate like connoisseurs and make judgements about the relative placement of their students that would adequately rank order the students. This process was generally accepted even though teachers could not always explain the criteria they were using. It is only in the wake of demands for increased specificity that teacher expert judgement is no longer sufficient. (p. 13)

My observations of participants in this study would support the view that teachers have relied on their 'expert judgement' and have not stayed current. Further, I contend that even a first year teacher does this as they quickly learn to shadow colleagues' assessment routines and/or fall back on assessment modes they were accustomed to as students. Therefore, the status quo in assessment is assured. There are many complex reasons for this situation, yet
I suggest, once again, that part of the reason for this situation is due to the fact that formal training in assessment is lacking in both preservice and inservice. Hence, there is a lack of basic assessment literacy. For example, Jan wrote:

I have little or no time to attempt to make up new tests; quizzes or labs with reduced prep time, more courses to teach, awkward schedules and bigger classes. I think what we are doing in this action research group is fine, but it is theory that will need a lot of help to put into practice. Next term, I have two Chemistry courses and two Biology with no prep. We have less P.D. time then before and a new curriculum. I know I have not taken an assessment course but when would I? (February 17th, 1998, p. 53)

Literacy levels were wanting because participants lacked professional development opportunities. This was due to cutbacks and overwhelming teaching demands, which curtailed opportunities for other professional development outside the school. These reasons, coupled with dated assessment expectations in the Ontario science curriculum, caused participants to lose touch with contemporary assessment debate focused on portfolios, journals, rating scales, conferencing, peer/self assessment, performance assessment, video/audio and photographs, both at the theoretical and practice levels. Instead, they were immersed in keeping their assessment flowing in the traditional manner, which meant participants had not been required to change anything in the last ten years. Participants had been maintaining the status quo over their entire careers. This inertia was also linked to their working in isolation. Participants worked in one department yet quite separately from one-another. They were isolated because preparation
times were not synchronised, schedules were often in conflict and the physical structure of the school -- separate classrooms spread across the length and breadth of the campus -- made it difficult to spend time together. For instance, a grade 9 or 10 science class could be scheduled for any available classroom due to a shortage of science classrooms. On one occasion Pat taught science in a 'wood shop' classroom while Cal was in a portable, across the campus, teaching science.

Participants were even isolated from their own Board assessment directives, and they continued to be unfamiliar with them. None of the participants had read the directives or knew they existed (Appendix E). Terms such as performance assessment and authentic assessment were not understood completely and, even though exemplars were used, they were not termed as such. Participants began to use these terms more often and more accurately and appropriately as the study matured. The text: "Principles for Fair Assessment Practices for Education in Canada" (1993), was not known to any of the participants. Therefore, many of the issues contained in the text, such as assessment limitations, beliefs, conditions, realism, appropriateness, fairness, and equity seemed to be new areas for discussion, and not areas they were just revisiting. So, in sum, their initial understandings and practices had been quite traditional, uninformed, limited and fixed.
Beginning Transformations

The third research question is, 'To what extent did these initial understandings and actual practices change due to the illumination of assessment praxes?' It seemed that each participant began to prioritise assessment in order to achieve certain goals. That meant planning the assessment first. Participants began to use an assessment, planning, learning approach. Assessments were tried that were more student-centred, including peer and self-assessment, and some assessment tools were even designed by students (a means to empower students). Jan remarked:

I'm looking forward to the next term when I can try out more of these ideas since I like to start day one and carry things all the way to the end of the term. My grade 11 chemistry class should be able to handle peer and self-assessment and I may try out the portfolio if I can get some place to keep these. (Journal, February 15th, 1998, p. 47)

Self-monitoring was tried in each class and plans were put in place to utilise science portfolios in the 1998-1999 school year. Written tests were decreased, as were quizzes. They were now less frequent. In making these changes the teachers believed that assessment feedback would be more immediate because they had less marking. The move towards more self-monitoring by students meant a shift towards student-centred and achievement-oriented assessment. Higher order thinking skills became more prominent aspects as performance assessments involving exhibitions and actual labs were planned and carried out in some classes. A shift from passing grade criteria to
achievement (self-referencing) criteria was discussed and plans were made to attempt to use it the following year. Students and teachers would openly track progress. Eventually the task of record keeping would become a shared responsibility. This change of assessment praxes in turn would ensure more attention was given to self and peer-assessment. As well, authentic (see 2.3) performance assessments would be given more attention. Greater assessment literacy was evident and previously unfamiliar terms, such as 'exemplar', were now commonplace. Bob wrote:

I feel like I can speak about assessment in more precise terms. Certainly these meetings have made me aware of how much progress can be made if we work together on one topic such as 'assessment'. We could use this approach at the Board level with the Science Department heads. (March 7, 1998, p. 53)

Also, teachers began to feel more like facilitators of learning than transmitters of knowledge. Lastly, participants found that they could solve their own problems through committed action and regular communications, without guidance from others (Board, Ministry). They learned that they can solve their problems by working them through as a group. They utilise 'other' in a different sense. Bob adds:

It seems as though our department can cope with the problems even if the study ends and we no longer have a facilitator. Pat has taken the lead on several occasions, and this is a good sign, as it helps others to look beyond the friction to smoother times. (March 9th, 1998, p. 54)

In review, I would have to admit that actual changes in assessment praxes
were less than I had anticipated. Perhaps my expectations were unrealistic or just naive. Pat seemed to be aware of assessment possibilities and she also believed she was doing everything necessary and didn’t see a need to do much more. I believe Pat, Cal and Bob would have done more if the two week strike had not deflated our study somewhat. It threw up obstacles that served as distractions via Bill 160 as we talked about having less prep time and increased workloads (classes). Cal did manage to make significant strides in assessment literacy. He was eager to show me how he was implementing what had been discussed. I recall him requesting that I attend a specific class where the students were doing some hands-on tasks that were authentic. The product was developed from an exemplar he had previously developed. He was eager and enthusiastic. Jan and Bob both suggested what they would do next year in order to prioritize assessment. Bob did attempt to construct an assessment tool (assessment checklist) in-class but I witnessed the attempt fall short, and it never really appeared again due to other course content requirements taking precedence. He suggested that the timing was wrong and he may have been right since it was late in the semester.

**Government Mandates**

In responding to the *fourth* question, 'What was their level of awareness of current Ontario government pronouncements and in what ways did they implement this knowledge?’ it was necessary to observe classroom actions and listen to each participant’s opinions, interpretations and questions
throughout this study. Each participant suggested that due to busy school schedules, student needs and hectic daily routines, little information concerning government activities (Bill 160 or the expert panels reviewing Ontario secondary curriculum) had been gathered in recent months. Pat’s journal was very forthcoming.

I have no idea what is going on outside this school. The union tells us this or that and I don’t have enough time to even prep, let alone coach, sleep, and have a life of my own. (February 5th, 1998, p.15)

Teachers had little time to get involved in other activities that were job related, such as union committees or distant Board events. Therefore, the conclusion drawn, in general, was that participants were not aware of the content of current Ontario government pronouncements regarding assessment, or their own Board assessment directives.

The fifth question which asked, 'what did participants learn about action research?' will be addressed in the next section.

10.2 Transformation and the Action Research Experience

Any growth in this study may be attributed to the flexibility of the action research mode we employed. Flexibility in action research is crucial: we have been warned several times in the past that there are “... problems associated with too prescriptive a framework for action “ (Hopkins, 1993, p 56). Each participant viewed our action research effort as an "... overall perspective, a
series of commitments . . . in the interests of individual and social transformation " (Noffke, 1997, p. 307). Transformation, as applied in this inquiry, meant a change in character and behaviour, usually for the better – though we did not fix a detailed agenda for that change in advance. We knew that we would react to one-another in various ways yet the extent and direction of reaction (reflexivity) was unknown until the process was well underway.

By illuminating assessment praxes, participants were able critique, compare and contrast their praxes with alternatives, try them (or, at least, some of them), and evaluate them. The intention, of course, was to find better ways to assess. Participants were then able to try alternative modes of instruction with increased levels of student involvement, methods that cast the teacher in the role of facilitator rather than content provider. Teachers were then able to focus more on assessment, than on content delivery. In doing so, they could identify achievement in various domains more clearly via process and product targets. For instance, Cal suggests:

> I have not had too many experiences over the years that have been as useful as this action research. Even though it is theory, it takes quite a bit of time. I find that I am more centred on assessment, rather than content, and that is good because the new Secondary curriculum will require us to do more assessment, I can tell. We're ready now, as ready as we'll ever be. (April 10, 1998, p. 62)

It is also worth noting Feldman’s (1999) point that “conversation can lead to action, follow action or be part of the action. Through the intermingling of
conversation and action, praxis comes about with its growth of knowledge, understanding, and theory through action” (p. 132). Thus in our project, the extensive conversations and debates can be regarded as a form of action. By engaging in action research, and reflecting on the activity, participants learned how to do action research. Participants became empowered to be teacher-researchers who where now able, in principle, to organise themselves. They not only learned about assessment methods, they also learned to formulate and address problematic areas of practice for themselves.

The investigation had the impact of a long-term professional development experience. Therefore, they have been professionalised. However, just augmenting awareness is not enough. Empowerment was a key indicator of transformation and this could be seen, as participants were able to overcome most of the existing obstacles, such as a lack of time, by making moderate changes to their lessons. In turn, this would trigger participants to make some structural changes to affect their assessment praxes.

Cal - I promise to do more assessment even if it means the portfolio.
Jan - Can we meet later to plan for portfolios?
Bob - I think we could bring this to a staff meeting to discuss.
Cal - Sounds good.
Pat - But we need to plan to include an exemplary portfolio.
Jan - Maybe in the summer . . . (April 23, 1998, p. 2)

My role was, in part, to support and promote conversation. All participants agreed that is was important to have a person facilitate, largely because a lack of time to organise meetings, decide on a focus, and so on, posed a major
obstacle for educators actively teaching a full timetable. Without a facilitator, the group would not have been so focused, nor so productive. Progress often came about when I provided ideas from published authors to inspire and, at times, provoke. For instance, I suggested teachers are often isolated, and cited the work of Rosaen and Schram (1997), Kosnik (1994), and the Royal Commission on Learning (1994). Another time, I asked if each participant thought they needed more assessment training. They replied that they thought they did. So, I provided the work of Earl and Cousins (1995), who suggest:
"Even though assessment and evaluation have always been their responsibility, most teachers have had little formal training in assessment and even those who have had training have found that it was not very useful in classrooms" (p. 13). The group generally agreed and this opened up the lines of communication concerning issues related to assessment training. It was a technique that was understood and appreciated by the group. I felt as though I should temper what I was putting forward because I did not want to insult anyone. I often began my comments by saying that I had a role to play and therefore I asked questions in a particular manner. For example, my means of igniting debate proved powerful, though to the reader of certain transcripts it may appear as if I was being too critical. Another time I suggested that the teachers needed more assessment training because they are, as Stiggins (1991) suggests, "...assessment illiterates..." (p. 535). The group rose to the occasion and spoke to this issue, when moments before a pervasive lethargy had gripped our group discussion. Similar bouts of discussion ensued
when a dialectic approach was used to promote discussion and heighten tension.

Each participant in this study knew that this action research effort, similar to other conceptions of action research, was concerned with the illumination of assessment praxes. We wanted to demonstrate the extent that participants improved practices, enhanced their understanding of practice, and improved the situations in which those practices were carried out (Stevenson, 1995, p. 199). In fact, it was one of our goals to improve. It was also understood that consensus was possible but not always necessary to validate values or beliefs (Beck, 1996), since there was sometimes value in diversity. Group members understood that it was necessary for each adult participant to respect and encourage one another, despite their differences. This understanding supported critical reflection on all perspectives, opinions and points of discussion.

Beck (1993) explains that change occurs through a process of "... communicative learning, which is concerned with 'hermeneutics' or interpretation and explanation of experience" (p. 258). Beck elaborates his ideas in terms of the Jurgen Habermas notion of 'perspective transformation'.

In my view, the perspective transformation approach, including the contribution of other writers . . . (for example, Habermas, Freire, Kuhn), has the potential to strengthen adult values education significantly. Of particular note is its focus on: (a) fundamental reflection on life's meaning and goals . . . . (d) the importance of dialogue as opposed to indoctrination in acquiring
values; and (e) the importance of action as a means of validating meanings and consolidating learning . . . . However, it's important to be aware of the shortcomings . . . when we are in the communicative mode of inquiry, which has to do with values, ideals, moral issues, and so on, we must rely on social consensus as the means of validation. (1993, p. 258 - 259)

A dialectic strategy allowed for opposing value positions in group discussions to mature, and sometimes reach resolution. One time, it was suggested that students were not motivated. I offered the view that the students were bored and marginalized due to a lack of inclusive assessment, resulting in disempowerment. Instantly, one participant stated that self and peer-assessment had been tried but it had failed, and that student input would not be valid in this type of assessment. I countered by suggesting there was too much control by the teacher. The discussion continued, as value-laden positions were revealed by participants. Oft times during our discussions, a Socratic approach was used, whereby questioning led participants to certain realisations which were often planned but not always. Just as often I was surprised by what I heard and saw.

Our discussions moved the group as a whole. We were more understanding of one-another and assessment in general. In this sense we were a learning community. We were learning about assessment and action research. However, our movement was not exactly of the type I was expecting, therefore I have been led to question the identity of this study and to look critically at how we "label it". It was not 'interactive professionalism' as noted in section 3.3, or
was it? We had set out to conduct an action research inquiry yet the study had changed. After three months our group had been solely involved in action through our conversations, and, I had not seen much action within the classrooms. As a group we became less enamoured with academic knowledge and the theoretical discussion of assessment and we needed a change from theory to something more specific, something that could produce a practical end result. The group, during our fourth month, was requesting a next step in the form of a working meeting where we would produce a product based on our discussions. Newby (1997) points out:

A vital insight underlying action research is that academic knowledge does not suffice for the solution of professional problems, and the sort of knowledge which can effect change must find its credibility through practical engagement with real-life tasks in collaboration with colleagues and pupils who grapple with the same tasks. (p. 82)

I believe the group's need to engage in real-life assessment activities via their request for a workshop validated the notion put forward by Newby. The group had begun the action research project with personal and professional enthusiasm, and with political correctness in mind. The political correctness came from the Board's professional development plans that indicated assessment and evaluation skills would be developed in 1996-1997 and put into practice during 1997-1998. The plan was a self-initiated process. However, it was agreed that our action research was helpful in these professional development efforts. It would have been easy to label the slow
progress as less than satisfactory; it could even have been labelled resistance or opposition. Yet learning about assessment and action research *at the same time* slows the pace of learning because there is so much to reflect on.

Rudduck (1991) adds:

> Teachers have to maintain their commitment to present structures while planning new approaches; they have to fulfil present expectations while considering strategies for changing those expectations. They will experience, to say the least, a mild schizophrenia. The appropriate virtues for the task of fundamental curriculum change are imagination, patience and immense fortitude. (p. 31)

So, now we had at least two perspectives — one from Newby and the other from Rudduck — that could balance our understanding of the action research process. We needed to apply our theory. We needed to test our theory via authentic (see section 2.3) practices in the classroom. But we had to remain cognisant of the schisms participants sensed due to the transformation and growth towards new or altered value positions. We became more knowledgeable about each other’s values and grasp of assessment to the extent that there was a sense that we were changing together. For example, Bob wrote, on April 22, 1998:

> It seems as though we just sat down and already we are finished. It has been a tough year but our group has really tried to deal with the big issues in the face of a changing educational system. We can use this work to go forward in 1998-1999 and hopefully when the new curriculum arrives we will be ahead in our thinking and knowledge. (p. 63)

Our diaries, transcripts and documents held the evidence. The task of locating
specific instances of evidence was not easy, but what helped was the fact that we were homogeneous, from one school and one department. Much of the learning reported above addresses the *fifth* research question: ‘what did participants learn about action research?’ In an attempt to answer, I want to make the point that participants encountered two levels of learning. First, they learned about assessment; second, they learned about action research. They learned that action research has the potential to bring about awareness via engagement in action, reflection, criticism and revision. In doing so they came to feel more assured of assessment. As a group, the teachers had more confidence and participants were much more aware of the common concerns of one-another. The collegiality fulfilled needs, especially in the current political climate induced by Bill 160. As they learned more about each topic, participants became much more eager to step forward and speak about the action research experience, assessment praxes and the needs of educators. For instance, Bob wrote:

> At a science council meeting this past Wednesday Cal stood up and challenged a point made concerning how assessment should be carried out this year. Cal argued that our needs are not being met, we have no professional development or time and we don't have a chance to work together. This was quite an event since Cal had never said anything before at a meeting. (Journal, January 22, 1998, p. 40)

Indeed, this action research experience was motivational; it enhanced communications and empowered participants to move forward and even share their new found insight with colleagues. Reflective practice enabled
participants to focus on assessment problems of immediate concern in order to work towards practical solutions, as well as to increase their understanding of personally significant educational issues in a collaborative manner.

In sum, the aforementioned sections provide a general indication, to some extent, of what is being done, why it is being done, how it is being done and who is doing the assessment in these secondary science classrooms. The following Chapter addresses research questions 6 and 7 by drawing attention to what we learned during this inquiry. Indeed, each question was a landmark and lamppost, which provided both orientation and illumination. We learned how to use an action research approach. We learned about assessment and action research. Participants respected and encouraged one another to critically reflect on all perspectives, opinions and points of discussion. It was generally understood that dialogue would give way to change and transformation. The group moved, to varying extents, from isolation or individualism to mutual support of peers and began to move away from a traditional means of assessment to one that was more varied, authentic, inclusive and contemporary. This was achieved in spite of a widely held group belief that there was neither enough time nor money to enter into professional development experiences of this nature. Each person learned about one-another and learned that dialogue and communicative action can be empowering even in the most uncertain of times.
Chapter 11

Reflections

This chapter, in combination with what has been presented in earlier chapters, contributes to a full account of the ways in which participants documented their thoughts, feelings and actions. Our understanding was enhanced by the use of a tape-recorder which permitted us to capture evidence that could later be transcribed, examined and sorted (see section 4.6). Further evidence was found in assessment tools, classroom observations and participant journals. Together these sources of evidence support most of the claims made and illustrate some of the learning and professional gains achieved. A detailed, frank and introspective account of my involvement is given that provides insight into my feelings during various stages of the project. Specific instances of learning about the study (action research), and myself, are also presented. In doing this, participants' voices have been highlighted and insights that address the planning and purpose of assessment, and the action research mode, are reflected holistically in the text as much as possible. By the end of this chapter I will have addressed action research and assessment from the positions of what I learned, the obstacles encountered and the commitment seen in and by the participants. Finally, I suggest a number of changes I would implement if I were to repeat this inquiry.

11.1 Purpose

Our purpose was to find a better way to assess by illuminating each
participant's secondary science assessment praxes. In the process our findings were compared and contrasted with the ideas contained in contemporary assessment literature and the recommendations of various official documents. We felt there was a need to critically examine what was presently being done. We believed this to be 'practical' action research, as noted earlier in section 3.3, since we were going beyond a specific agenda to bring about assessment effectiveness and professionally develop ourselves in the process. We hoped to realise a better understanding of assessment and our assessment praxes, and establish a means of growth. We regarded this as action research.

To guide myself, I considered the insights of researchers such as McTaggart (1991), who states: "Practical action research may be fostered when the facilitator acts as a process consultant. . . . The outsider establishes co-operative relationships with practitioners and helps them to articulate their values and concerns, to plan and to monitor action, and evaluate the action and its effects " (p. 29). These objectives were made easier to achieve because, coincidentally, the focus on assessment praxes complemented the professional development goals of the science department, the school and the Board during the 1997-98 school year. So, we moved ambitiously into a 'practical' action research mode of inquiry. We attempted to act, reflect, and revise recursively, as is customary in action research. However, in the end we managed only to act in a limited manner. Most of the action was limited to conversation and any actual changes to practice were minimal and sporadic.
All the way through our study these cycles were difficult to disentangle because they merged and yet there was a sense that each participant experienced these cycles recursively. Throughout the study I struggled to fit the necessary interviews and group meetings into busy schedules. However, in spite of the obstacles, we successfully completed our schedules, obligations and commitments to one-another.

11.2 Focus

As we systematically improved, via collaborative 'practical' action research, each of the self-directed participants reflected upon assessment. The process required that I also focus on an agenda that included not only assessment, but also professional development outcomes and expertise in and enthusiasm for action research. In order to nurture these outcomes I allowed participants sufficient latitude to deliberate while I was careful not to be overly prescriptive (Hopkins, 1993). As a result of this latitude, I believe there was a great deal of support for our study from within the group and within the school. In turn, this support produced the required levels of commitment and dedication to complete this focused inquiry.

11.3 Planning

In a journal entry in April, 1998, Cal reflected:

I didn’t really value what I did until we took the time to look at it carefully. The time spent examining assessment became the most important thing in my day, I think. It created a need to plan more and
made me more conscious of what I did. I then had a need to share my observations, which was kind of new for me, as I used to keep it inside, like most teachers, it makes you crazy, that's why I go golfing, to get it out. (April 10th, 1998, p. 35)

At first I glossed over this entry and forgot about it. When I reread the journals I was surprised to see how well it described our experiences. It seemed that at every interview and group meeting we discussed the past, the present, and often the future direction of some element of assessment. These actions became a pattern that repeated itself throughout the study. We spoke about what could be done and how it could be done (planning). We acted on these thoughts, both in theory (i.e., in conversation) and, sometimes, in practice. Following these actions, we would often reflect on both the theory and practice, in order to further examine and illuminate our assessment praxes. Indeed, “in action research, a single loop of planning, acting, observing and reflecting is only a beginning; if the process stops there it should not be regarded as action research at all” (Carr and Kemmis, 1986, p. 185). Our project did repeat this single loop many times, to the point that it became routine and second nature to each participant.

As I set out on this journey I thought of the planning (prospective action) and the entry, which set the possibilities for the study. The formulation of the problem and purpose led to the development of an agenda. This action initiated personal reflection (Elliott, 1991). As I identified problems in participants' assessment practice, and proposed actions to examine them, I was working to
develop assessment understanding for myself and others participating in the action. Thus, my agenda shifted and re-directed the study towards new targets. I followed the advice of McNiff, Lomax and Whitehead (1996) by attempting to answer the key questions, which they had outlined in their text: *You and Your Action Research Project*. For example, I found a focus (assessment praxes), sorted out why I was interested in this focus, identified the type of evidence I would need to illuminate what was happening, and decided on what I could do as evidence revealed itself. These key questions and several others were instrumental guideposts for me as I built a comprehensive view of science assessment praxes. I recorded my thoughts October 15th (1997),

I find that meeting so many new people has caused me to lose sight of why I'm here at the school. If I didn't have a plan and schedule I believe much of the time would slip by quickly and I would fail to get it documented. It makes me anxious and uncomfortable to know that I have to produce something noteworthy. I reassure myself that it will be interesting without me having to do anything more than record and collect evidence. Still, I get this nagging feeling that I'm not doing it right so, I reread a few texts and I calm down ready for tomorrow's interview. (p. 10)

11.4 Research Mode

In working to improve the effectiveness of their assessment procedures, the participants were often very dependent on the researcher, as in technical action research. For example, I provided many of the necessary opening questions and was a resource person much of the time. Since I did not have
classes during this study I was the person who could do the extra photocopies, overheads, and public relations with school and Board administration. Most of the time I had to go looking for participants, as they were very busy in their roles as teachers dealing with students, staff, and parents.

In addition, however, my role was Socratic and I aimed to encourage practical deliberation and self-reflection on the part of participants, which constitutes Practical Action Research. Looking back on this experience, reflecting on the growth, the development and the relationships formed, brings a sense of accomplishment. At the onset of this inquiry I immersed myself in the commitments of acting, reflecting and revising. As a result, my vision and perspective were changed. Yet, as time passed I became accustomed to this perspective and its cyclical nature to the point that I became clearly aware of my own transformation. My assessment paradigm had shifted, from a belief that we had to throw away traditional assessment practices completely, to a series of beliefs about science assessment praxes that consisted of a mix of traditional and contemporary assessment modes. It was a process of realisation and transformation that came upon me gradually.

11.5 Commitment

Our group had to commit itself to a system and structure that would last the better part of one full school year. In doing so, each participant fulfilled commitments that are essential in action research. We knew that action
research was an overall perspective involving a series of commitments. Using
this approach allowed us to problematize "social practices (including that of
action research itself) in the interests of individual and social transformation"
(Noffke, 1997, p. 307). Put another way, we can say that we also embraced "a
series of commitments to observe and problematize through practice a series of
principles for conducting social enquiry (the praxis of a social science?)"
(McTaggart, 1996, p. 248). To achieve these commitments and problematise it
was necessary to reflect on the past and present in an effort to improve and
learn. Our group followed these actions with more commitments to refashion,
and basically made plans to change in the future. Participants believed a
better future could be realised due to our current efforts to improve. We
understood that our efforts to revise current practices would impact our
personal, professional and political praxes at school and in our lives.

Throughout our study as we gathered our evidence, in a committed fashion, we
made efforts to create action. Our actions were largely limited to, and located in
our conversations, meetings and communicative activities. As a consequence
there was limited time for classroom action. We studied our reflections and
tried to imagine how we could move forward in a manner that was reasonable
and acceptable. There were times when the group's level of commitment was
challenged. For instance, at times I wished to skip an interview or meeting
because of the way I was feeling, or because of the weather or the motivational
state of the other participants. Participants were challenged by a province-
wide teacher's strike and by increased workloads. The resultant mental fatigue impacted adversely on attitudes (see tensions – sections 11.10).

Often I entered the recursive discussions in order to support and stimulate further participant reflection. The resulting agreement or disagreement was engaging, often caused debate, and provided fuel for conducting interviews which followed the guidelines. (Appendix D) The probing questions made it easier to characterise participants as the study matured and the commitments of participants to the community increased.

11.6 What We Learned

During the project we developed into a small learning community in which, to the best of my knowledge, everyone participated equally and fully in our task of improving assessment. Carr and Kemmis (1986) add:

A key aspect of this process will be that all present can really participate equally in raising questions, contributing suggestions, and so have equal opportunity to raise and test validity claims. After all, if each member cannot participate in the discussion fully, it will not be possible to assert that conclusions reached actually represent the best thinking of the group. If only a few participate, the understandings achieved will be the understandings of the few, and the claim that they are understandings of the whole group will be hollow. (p. 147)

During this study I learned that it was possible to get all volunteers to work towards a common goal and actually enjoy it. This helps to answer, in part, the *sixth* research question which asks, 'what other learning and professional gains
were realised during this study? To further answer this question consider what
has been reported so far in this inquiry and add to it a belief offered by McNiff,
Lomax and Whitehead (1996), who suggest that:

Life is a process of constant learning, in touch with our
imagination and daring to do. Adults often become unnecessarily
constrained in their thinking, and feel that they have to have the
right answer all the time. It is OK not to know, to want to find out.
Action research means finding out - mainly about you - in order to
improve practice - mainly yours. (p. 33)

It was to this end that I hoped participants found out about better ways to
assess and found a means to professionalise practice using an action research
mode. We discovered that we could make 'time' to meet and fulfil the
commitments necessary to complete this study.

Through action research each participant came to understand certain things
about themselves, as suggested by McNiff, Lomax and Whitehead (1996).
Often it was during an interview or group discussion that a sudden realisation
occurred. For instance, during this exchange, Cal acquired a sense of just how
isolated he had become.

T.R. Do you ever have an opportunity to have another person,
colleague or adult come into your classroom to assess a
performance/exhibition?
Cal - We do that on certain projects such as the Science Olympics. But I
have to work alone. I choose to because when I'm ready to prep, no one
else is around during the day or we live too far apart. I have to
coach and I need time for myself. We all need to have a life outside of
school. (December 3rd, 1997, p.2)
Cal later noted that, “the Science Olympics are a once a year event that lasts only one day out of 180 days of instruction and this is not enough collaboration” (Cal - Journal, December 12th, 1997, p 10). Clearly there was a substantive feeling that he needed to work in less isolation, perhaps through team teaching.

Another participant, Bob, recognised how infrequently he addressed assessment with his students. Previously he had prided himself as a good communicator.

T.R. - Do you ever discuss what the target is with the class? 
Bob - On the first day that they come into class they are given a number of pages. (October 8th, 1997, p. 4-5)

However, after that first day, little discussion ensued about assessment (with his students). Bob later mentioned how much more attention he needed to give assessment and communications in order for the students to do better. Both Pat and Jan experienced moments similar to these. All participants realised images of themselves as theorists as well as practitioners via our action research approach. Pat wrote:

Sometimes when we talk [theorise] about assessment I can see myself doing it. When we first talked about exemplars and I wasn’t familiar with the word I felt like I hadn’t kept up. I thought I might be letting my students down by falling behind. Now I use exemplars for almost each class and I remember some of my better teachers showing me what they wanted and this helped me to get better grades. (March 20, 1998, p. 28)
Initially, I believed we could become theorists because a need was being met as our forum provided a time and place to communicate with one another. I believed my role as a facilitator was to help participants "... acquire the skills necessary through reframing real practical dilemmas with ever-deepening levels of understanding" (Hannay, 1998b, p. 11). I attempted to do this at every opportunity. Bob wrote:

I can’t believe the time has gone by so fast. It seems as though we had just begun to talk about assessment, and that through this discussion each of us has changed. I know I think differently about how I assess. I now know that we need to have students complete more self and peer-assessment and I feel a little better about leading this change as each of us has learned more about assessment. It is no longer a question of will I change things. As the department head it is more a question of how much and how fast. This concerns me; I feel the government has more surprises in store for secondary education in the province. I had time this year to experiment [our study] and this summer I’ll have time to put together more resources and by September we shall see. (April 14th, 1998, p. 14)

Personally each participant had journeyed towards greater self-knowledge.

Cal wrote:

This year has been hard for all teachers in Ontario. The one thing I looked forward to each week was time to get together and talk about things. When we talked I felt it was different than a staff meeting. I felt I could listen better and I am heard. I thought that it was something I might do in the future if I choose to go on. I guess I could be a researcher too. (April 10th, 1998, p. 36)

Each person suggested that assessment would now be more in the forefront of his or her consciousness while planning and teaching. Collectively, it was agreed that our reflective practices had helped them to reconnect the values
and beliefs they held today with values and beliefs they first held as students. In other words, entering into group discussion concerning teaching energised us. For example, Cal remarked in group discussion: "Our group has, I think, begun to understand why we assess the way we do and what is surprising is that it is so much like the way we were assessed as students I think" (March 4, 1998, p. 2).

Participants learned that they can learn: that they can acquire new professional skills and understanding. Our group was more confident because of their newly acquired expertise in assessment. They regard themselves as more professional, able to develop new knowledge and new expertise to meet the changing demands of education in the 21st century.

11.7 What I Learned: Revisiting the Journey

It has been stated that "the process of coming to know ourselves as practising teachers is difficult. So much of our personal practical knowledge is tacit, unnamed, and because it is embodied in our practice, difficult for us to make explicit" (Connelly & Clandinin, 1988, p. 33). I appreciated this 'truth' and throughout this study encouraged and supported participants as they took steps towards making this tacit knowledge something that could be articulated, documented, transcribed and critically examined. I learned that this was an opportunity to critically examine tacit knowledge that would give way to discussion, refinement and then action. The personal practical knowledge that
teachers brought with them became the transcripts, documents and journal notations. I learned that each and every step of the way allowed for more acting, reflecting and revision. As a result, the steps of this inquiry are quite entwined.

As I approached this study, I was quite aware of the level of stress I was managing. I had a family and we had just moved into a smaller home so that I could take a leave of absence without pay to complete this research. I worked very hard to get the proposal through by September of 1997 since my leave began in September and I wanted to begin. Final approval didn’t come until early October; hence there was some delay, which upset me a bit. I risked a lot by walking into a secondary school that I hadn’t been in before. Would I be rejected or accepted? I was nervous, and yet I had faith that I would get permission and find four science teachers who would agree to become participants. My initial meeting with the Principal was quite positive, and as participants signed the consent forms my concerns shifted to other factors. I worried about the quality of the meetings and often wondered if participants would see the value in what we were doing. Gradually, I gained confidence in the project as I learned that a yearlong professional development task of all staff at this school was to centre on assessment. Given this coincidence I began to think that my path and work here at this particular secondary school was meant to be.

I frequently consulted with the action research texts since I suddenly had many
questions, which created uncertainty for me. I was concerned about the basic elements of action research. I often asked myself, was I doing this right? Have I left anything out? At times I felt empty. It would have been easier to continue teaching and forget about any expensive and arduous post-secondary work. However, I had ventured too far in this journey to stop or turn back. What lay ahead was unpredictable. I learned that there was no forecast to guide me. Even the action research texts seemed too generic to answer certain questions. It made me tense and somewhat confused. “Is this really what I want to do?”, I thought many times. As the days passed I began to settle into the year. Transcribing the tapes was very difficult and time consuming. It was all I could do to get the last session typed just before the next meeting and then I would repeat this cycle of tape, transcribe and tape again. On the positive side, our interview schedule unfolded as planned and I was amazed at how well we worked as a group. All meetings started and ended without anyone getting up and leaving due to differences of opinion, and no one dropped out. I realised that I was becoming successful as a facilitator and leader. It was at this point that I began to enjoy the experience and thought about doing research full time.

These thoughts gave way to others that were not so positive, as the province-wide strike neared. I once again became upset with the fear that my research may not be completed. I wrote:

What a time for a strike, if I didn’t have bad luck I wouldn’t have any.
I feel so lost. If the strike goes too long I’ll have to change a lot of things. Maybe I can do the study while they’re on strike. No, that might not be a good idea. Well, the weather is no better than the mood of teachers, cold, freezing rain, ice and it’s not yet November. (October 29th, 1997, p 15)

By the end of the second week I once again visited the picket lines to talk to participants. I heard the strike would end and I was once again optimistic. I would make up for lost time by adding in the cancelled dates as soon as possible. Bob and I would spend time almost each day talking about assessment, whether the tape was on or not. We were motivated and it was like a hobby for us.

Each participant in the study enjoyed the topic and I was careful to treat each person with respect. I tried not to judge or dictate, and I spoke about how I was feeling in a direct manner. It wasn’t really until I started writing that I had to label participants as being this way or that. For instance, Cal was, I judged, very much like me (assertive), and at times he seemed restless and talked about transferring to another school, as he had been at this school for several years. Jan was quite joyful and I sensed that she and I could work together at any time. Pat was fresh out of a Faculty of Education and was distracted (many thoughts in her head) and often hurried discussions, which irritated others and me at times. This reaction to Pat could be labelled tension. In this study tension was something I did not attend to straight away in my data analysis since I was focusing on other areas. Tensions seemed easier to
ignore than address at first, and the issue of reporting accuracy bothered me since I may inadvertently incite further tension if I seemed to be taking sides or writing about something from a limited perspective. As participants are reviewing transcripts they might detect wrong messages in my writing. It wasn't until about January that I focused on some of the tensions I had noticed. I tried to resolve these apparently interpersonal problems with a 'no-lose' approach. This meant that I was direct and respectful in the face of any conflict. I wrote in my journal November 19th, 1997:

Today I spoke to the group about conflict between people and each one suggested that some things are dealt with and some are not. No one would talk about the other but we had a couple of good laughs about staff meetings and how some staff take up all the time with complaints, and as a group it is hard to get consensus no matter how good the leader is as a negotiator. It reminded me of some memorable staff meetings I've been part of. (p. 22)

As we pushed through January I remember feeling annoyed by the fact that our schedule tied me down somewhat. I was becoming weary at times with the workload. What kept me going was the enthusiasm of the participants who seemed to welcome the adult conversations we had. I began to see myself as a 'cheer leader'. I was always greeted with a smile - the kind you might expect if you shared a secret with another person, an unspoken understanding. This intrigued and motivated me at the same time. With winter leaving, and the trial and errors of the classroom becoming easier to deal with, we could say that everything was going well. As in-class assessment efforts increased I began to capture some of that feeling I had had in the first few months. The end was in
Those first few days of data analysis in March caused me to question my methods. It wasn't until I found a means to sort and organise data that I began to think I could complete the data analysis effectively. I was tormented by the slow and intense work required producing transcripts. It was very demanding and surprised me. When the journals were handed over I had the feeling that the participants had not put enough effort into them. They seemed short. Most were under 50 pages. Yet, their contents proved a rich and vital source of information. Therefore, my initial reaction may have been too strong and premature. As I read the journals I was swept up in the some of the descriptions and most of the insights which subsequently made their way into this text.

By mid-April our study was nearing an end and the group seemed quite content with our work. I felt that our initial months discussing the theory of assessment had been a necessary phase that all of us needed to experience. Following this phase was a time of practical application, which lasted from about January until April. The practical application phase saw participants struggle to implement varied and alternative assessment. The struggle I observed caused me a great deal of frustration: somewhat like the spectator at a sporting event, who has a better view of the questionable plays and yet is powerless to intervene. I observed classroom assessment attempts that did not always succeed in my eyes. They were discussed, and sometimes the differing perceptions of the
teacher caused me to rethink my perceptions. My final few acts — that included interviews, classroom observations and the collection of assessment tools — were exciting as culminating activities to the action research process. Our relationships were now strong. After all, we had shared both feelings and thoughts over eight months. Therefore, we had a shared past. My relationships with Cal, Bob and Jan were of a high quality, I believe, because we had shared so much in the area of attitude, experience and insights from the onset of this study. Pat and I shared a good relationship because we had roles that seemed complementary. She needed to vent, and share, and I was a supporter and facilitator who had time to listen. When listening I tried not to be dominant, even though it was mostly my agenda we were following, and Pat seemed to be comfortable with my stance. We struck a balance in our discussions, at least I thought so.

11.8 What I Learned about Action Research and Assessment

Question seven asks: 'What did I learn about action research and assessment through involvement in this study?', I suggest that assessment has come to mean considerably more than the collection of student data. For example, assessment can be the very means to begin planning a course, as is customary in outcomes-based programs, where you want students to acquire particular knowledge and skills. In this situation, a well designed assessment scheme can be a major factor. Even though this study confirmed many of the views I already held it did cause me to embrace the view that a mix of traditional and
newer alternative and varied assessment is best suited to achieve a wide range of curriculum goals. For instance, to achieve the complex and multifaceted notion of scientific literacy requires assessment that is wide ranging, in both form and function.

This study has taught me the following:

(a) Assessment should match and complement the purpose, and be responsive to the context in which it is applied. For example, if we want to describe the students’ classroom behaviour a teacher can use anecdotal observations. If the same teacher wants information on presentation skills then a demonstration task needs to be planned and carried out.

(b) All assessment activities should allow students to demonstrate what is being assessed. If a teacher is assessing how well students have learned content, a short answer or structured response assessment can be used. If a teacher wants to assess skills then a rating scale could be used as the student completes the task(s).

(c) The assessment process for judging and scoring needs to match the method chosen and needs to be applied in the same manner each time.

(d) The assessment should, as often as possible, be developed co-operatively with students (a key element in empowerment) and with staff and administration (thus ensuring greater ‘transparency’). For instance, working together with students to produce a peer-assessment tool that conforms to Board and Ministry assessment principles is essential. This assessment tool should also
be compared to examples found in the text: *Assess for Success* (Midwood et al., 1994) and be guided by the *Principles for Fair Student Assessment Practices for Education in Canada* (Joint Advisory Committee, 1993).

(e) Assessment information should be easily understood and reflect what was observed truthfully so that parents, teachers, students and administrators can use it. Consequently, the result of any provincial assessment or standardised test needs to be interpreted and communicated in a manner that is useful to all stakeholders.

However, even with all these changes, assessment will not be perfect: improvements can always be made; the task of development is never-ending. In a sense, students ‘come to class’ well before they present themselves. We often first learn about them via their educational file (OSR), informal contact at school functions and anecdotal conversations with previous teachers. Of course, our understanding of students becomes deeper and fuller during a semester, as we teach them. And it continues after we have taught them, as we hear of their progress beyond our class, possibly for years to come.

Likewise, in this inquiry, my relationship with participants began when I decided what school I would approach and continued throughout this study. It may continue even though the project is now officially complete. We may continue to correspond; we may meet at conferences.

From the beginning, with the approval of entry by the Principal of the school,
the approval of my proposal, and the commitments participants made to this research effort, I was sensitive to the precarious perch I would have throughout this study. I went from a role where I was a classroom teacher and graduate student to that of an action researcher, with many unaccustomed obligations and matters to reflect on. I found this position stimulating, as my research responsibilities caused me to think more as a facilitator independent of any Board, Principal or parent. I sensed that I had complete freedom, limited only by the actions of the participants and the ethics of the research situation.

Upon reflection, I believe that my participation met my esteem needs and met participants' esteem needs. As Rosaen and Schram (1997, p. 256) point out, action research "... enables teachers to focus on problems of immediate concern to work toward practical or short-term solutions, as well as increase their understanding of personally significant educational problems through collaboration ...". I felt rewarded because, after a number of years of teaching and studying education, and having completed other research, I had developed a level of confidence and eagerness to engage in more research. Doing research has stimulated my understanding, whereas reading about research and listening to others talk about research is somewhat limited and limiting. Participating in the research led to change and achievement in the personal, professional and political domains.

Personally, I have a greater understanding of the articles I have read on action research, since I now have more insight concerning the difficulties
encountered in the field and in the writing of such research enterprises. I can reflect on the stress I felt, and the amount of energy and financial commitment needed to support this research. Professionally, I have grown immensely. I have more confidence in my ability to carry out a project and work with others. I believe I have taken steps to enter a world that is rich in tradition and has a great deal to offer if I choose to pursue it. Politically, I have become more skilled interpersonally and will use these skills in the future. I have completed something that is important to me and hopefully to others as they may see useful elements within the lines of text.

The action research literature guided this field research. I found myself returning to the texts to clarify my position, and to seek guidance. For instance, the McNiff, Lomax and Whitehead (1996) book, entitled: You and Your Action Research Project, proved to be a step-by-step directive that was written to allow readers to expand on the ideas within. One notion that I recall during a period of reflection had me thinking about a metaphor for this entire research experience. I remember thinking about how similar this experience was to a scavenger hunt, in that I knew what I was looking for (assessment praxes), yet I was uncertain how to find it and what it might look like when I came upon it. I had a plan (proposal) and a number of texts (resources) to guide me, but the process was very unpredictable, as participants and the roles they maintained were bound up in their own autonomous spirals of action research. I had to adapt to participant needs. I had to change my schedule, be non-adversarial,
supportive and nurturing, yet Socratically challenging.

The concept of team in action research is quite useful. As a team member there are roles that players need to assume. Of course, having a coach can facilitate some of these roles, or can facilitate the process, yet providing guidance requires a sense of the quality of life within the team or group. A sincere and open gesture of support or resources may be rejected if it is too directive (Hopkins, 1993). This is a problem in every action research project, yet there are ways that these problems can be kept in check by observing several basic tenets of action research. For instance, using good listening, management, collaborative and intrapersonal skills and using a style of language that is inclusive while being respectful (ethically) (Carr, 1995; Elliott, 1991; McNiff, et al. 1996), contributes to overall team success.

11.9 Assessment: Changes and Obstacles

As noted earlier, prior to the study I thought that there was little room for any traditional assessment in the secondary science classroom. Now, however, I believe that there should be a mix of traditional and alternative methods in order to provide a balanced assessment that is also practical within the prevailing teaching conditions in Ontario Secondary education. Traditional assessment is efficient, yet often only provides a limited view of achievement. Traditional assessment often fails to acknowledge the significance of various conceptions of student achievement. Outcomes related to real-life
communicative abilities involve application, decision making and interpersonal problem solving. Therefore, we need assessment tools that are more able to tap into these abilities and yet at the same time empower students. We need more performance assessment that is supported by peer and self-assessments. These assessments need to be partly developed by students – partly because that, in itself, is empowering and partly because student design will assess the highest levels of thinking. Also, the use of portfolios, student and teacher logs/journals, checklists, independent study units, interviews, and the like, assembles a more complete picture of student progress and achievement. By using these modes we can realise the extent to which the wide range of outcomes encompassed by the notion of scientific literacy may have been achieved. Scientific literacy can be seen as real-life communicative abilities or as "... the acquisition of science knowledge, skills, and attitudes needed to function and contribute successfully in the world " (The Ontario Ministry of Education and Training, 1997d, p. 3).

Nonetheless, until the system changes fundamentally, and that is a very optimistic stance, science educators have few alternatives to tradition -- given the reduced preparation time, multitude of needs, curricular pressures and isolation of secondary teachers. Simply sensitising teachers to the need for change is not enough if we do not also empower them to make the structural changes that would enable them to implement their 'new' preferred praxes. At the very least, they need time, support, exemplars of good assessment items,
and practice. They also need the opportunity to work in mutually supportive
groups. This study has shown that significant gains can be made in knowledge,
understanding and attitude in even a short time. What we need is the
opportunity for teachers to work in this style on a continuing basis; after all,
“teachers’ purposes motivate what teachers do” (Fullan & Hargreaves, 1991,
p. 19). Our study gave participants a voice, in order to discuss issues of
praxes, in a forum of commitment with a common, purposeful goal, in order to
find a better way.

11.10 The Action Research Experience

Tensions

In each case study and group interaction tensions were present, varied and
noted. For instance, conflict could be found as we shared our ‘good pedagogy’
beliefs and our expectations for action. Even though these were distinctive
common ground could be found. We generally agreed that we were there to
facilitate the development of ‘good citizens’ who were knowledgeable, socially
skilled and capable of applying practical skills. We had enough agreement in
this area that I believed this was not a long-term or on-going source of tension
and I therefore swept this issue aside. Another time it was the demands of the
Ministry, as communicated through their assessment and reporting documents,
which caused tension. We each complained about the lack of insight the
Ministry seemed to have concerning practising teachers and how policy was
often unrealistic. These issues proved to be a good means to ignite intense
conversation throughout the life of this study and I used this feature when necessary. I saw it as a good source of creative and rigorous debate, not as something that was an obstacle to our progress. Interpersonal styles created tension at times, as team members struggled to argue a point or debate an issue. Much of the tension was dealt with directly by continuing our discussion or continuing to listen to a participant. In handling this tension in this manner, I believed it actually encouraged more sharing of feelings. In a similar way the structure of our study seemed helpful, as both group and individual meetings were not overly long. Instead they were useful intermissions from the hurly-burly atmosphere in the school and classroom. A need for more time, both in this study and in each teacher's schedule, produced tension that we tried to cope with, as we saw no immediate way to find more time. For me tension was not necessarily a negative entity, sometimes it was an opportunity (what we might call "creative tension"). These illustrations of tension seemed like opportunities for me to align my findings with other research findings and work through group dilemmas collaboratively. However, I had to be certain of my strategies since educational literature is ripe with suggestions and illustrations of potentially destructive or debilitating tension (Fullan, 1992, 1997; Schoonmaker, 1998; Wideen et al., 1998). This literature seems distant and unfamiliar, until you yourself experience the same degree of tension. Conversely, I felt compelled to illustrate that conflict did not exist in most situations. Hence this need to support my claim of harmony was in itself one of my sources of tension throughout this project.
I chose to present and introduce our project to the school via a staff meeting in early October. It was at this meeting that I explained why this study was necessary; how we would do it; where we would do it; when we would do it; what would be done, and who was involved. The purpose of the presentation was to gain support for our project in public, and to demystify the process of action research. Bob wrote in his journal:

The presentation was appreciated and I now understand what we are doing since we really didn't do much in my preservice program. My need to move forward is greater now since I am looking forward rather than looking back. I think our group will work well together as we did before this exercise. (October 9th, 1997, p. 1)

Bob's journal was honest and provided valuable insight. From the onset we were aware of dilemmas this action research process might cause, such as possible changes to our timetable, extra duties assigned to participants, Board intervention (on-going permission to operate), and the Ontario Ministry of Education changes to legislation (Bill 160) which led to a two week strike. So, in order to diminish some of the tension, I also presented our project at the board level. I wanted to allay fears and shore up administrative support that could possibly ease some of the tensions. It may have had the opposite effect but I thought I would be proactive rather than reactive.

Conflict seemed inevitable and was observed and noted in varying degrees in this study. For instance, on Wednesday January 7th, 1998, these revealing
T.R. So how would you change the year at the Faculty of Education to make it more useful?
Pat - Practical exercises such as making tests for grade 10 science - stuff the reflection - we had reflection right out the wazoo.
T.R. You sound a little bitter: Are you bitter?
Pat - No, I got my piece of paper and my job like all the courses - I had to take to become a fitness instructor - some were good, some were not. (p. 1)

Pat seemed full of contempt for the system that trained her, the Faculty of Education. This illumination is not new; many other researchers (Wideen, et. al 1998) have put forward similar findings. Pat also voiced disdain for reflective practices, which impacted upon our study I believe. Other participants painted Pat as 'just another first-year teacher who had a lot to learn'. This reality can be better understood if we consider that there is little evidence to support the suggestion that preservice teachers' develop an understanding of reflective practice (Wideen et. al 1998). In response to Pat's devaluing of reflection, her journal was quite brief, yet this may have been more a feature of limited time than passive aggression towards reflection and writing.

Pat also saw and felt systemic conflict, for instance a comment from October 8th, 1997, addresses colleague collaboration:

T.R. - Any chance for Cal or others to help?
Pat - No, because they [colleagues] are overloaded. I am overloaded. I can't get to them and he also doesn't know the focus of the class, which is fine. In his class he might have focused on specifically this and was
looking for that. Whereas I chose a different angle and I was looking for that, and so . . . (p. 7)

Perhaps she believed, as do many first year teachers, that she should be the expert or that everything depended on the teacher, as teachers are self-made (Schoonmaker, 1998). Pat felt anxious possibly because she compared herself unfavourably to experienced teachers. She may have felt bad about not having the skills, knowledge and confidence levels of veteran teachers. We do know that teachers are not self-made, this is a myth. Yet, a first year teacher (at the very outset of their career) may resort to these kinds of beliefs. These beliefs can actually heighten tension for novices, and others who propose alternatives while in discussion with them. Pat had many sources of conflict. She even reacted badly to praise and whether it was credible or not. For example, on Wednesday March 4th, 1998 she said:

You don't need the pat on the back. If you are doing your job that is all you need — we need to strive for competency — not a pat on the back — I have a built-in feeling about how I'm doing — keeping up to date is intrinsic — you don't need someone there saying you're doing a great job. It makes me angry to have someone tell me I'm doing a good job when they are not any more advanced than I am. They have no background, a Principal or Vice-Principal who have no idea how you teach or what you teach and they are telling you, you're doing a great job. (p. 2)

Pat clearly had many sources of tension both from people and the structure of systems. Having teachers illuminate practice via discussion and reflection can be a first step in learning how to teach, yet development takes time and readiness is an issue. The action research process itself can be a source of
tension – the criticism and counter criticism, the clash of ideas, the exposure of one’s beliefs and feelings can be very threatening for inexperienced and less confident teachers. So, we need to ask ourselves whether action research is too emotionally demanding for novice teachers. Was it a good idea to include Pat in this study? From her perspective it may have been damaging and from the group’s perspective it may not have helped our study by having a novice teacher within the project. However, I believe it was good to have Pat in our study since she was experienced in reflection and had a perspective that proved to be different, useful and thought provoking. For Pat, and really anyone moving from preservice to inservice, the shift from idealism to practicality is both stressful and necessary. As well, action research that is supported leads most often to the "... flowering of empowered teachers " (Wideen, et. al, 1998, p. 159).

Hindsight

It is only at this point that I begin to realise just how smoothly this inquiry proceeded and how fortunate I was to be in the right place at the right time. I walked into a secondary school that was focused on assessment as a professional development target. The first four teachers I approached joined the study and were committed throughout the year to a rigorous schedule that challenged them, even through a two-week strike.

I have learned that sometimes it is what you do not do that makes things
successful. For instance, I could have been more officious and caused undue stress and defensive postures. I could have been less persistent, committed and supportive, and watched the quality and standards ebb ever lower week by week. I could have chosen teachers who may have subsequently dropped out. I could have approached the Board rather than the Principal, and been denied access. My approach seemed to complement the study whether by design or by good fortune. I would characterise my approach as informed, honest, sincere, consistent and informal. However, this approach may not work at another time or place. I was fortunate.

Action research is an unassuming, informal approach to research that supports participants and nurtures growth. Action research, through a variety of approaches, can be a very challenging enterprise that can cause some teachers (participants) to be very anxious and uncertain. Yet, it is a means to bring colleagues together in order to take control of perplexing issues in education, like assessment. At times, action research may feel unlike research because of the latitude found within this mode of inquiry. Action research, as a vehicle, lends itself to a manner of questioning that can be increasingly challenging. There can appear to be no succinct conclusion due to the ever-changing contexts and recursive nature of discussions. However, I suggest that those who contemplate action research become informed and knowledgeable about what can happen in action research before attempting such an enterprise.
Starting Again

The following section addresses the possibility of what could be done in order to be better informed and/or prepared if this or similar research were repeated. I suggest modifications, and indicate changes that could be made for future endeavours and provide details of what would remain the same. Further information concerning aspects for which one cannot prepare, because of variables involving teachers, schools and the focus of attention are also discussed.

If this research study were to be repeated, it would be useful to have more help (research assistants). This type of research could use two or three assistants to fully realise its potential. I could spend more time in classrooms and offer more vignettes of individual teacher's classrooms. While I was doing this, one assistant could transcribe tapes, one could scan transcripts and the other person could gather even more on-site evidence. The tasks of proof-reading, sorting and maintaining continuous contact would then be shared, thereby enhancing all facets of the study. The evidence from within the data may be more exact (validity) and forthcoming as multiple assistants sift through data more often with different perceptions and come to consensus. The principal researcher would then have more time to reflect on the discussions and evidence. The other two facilitators could provide differing perspectives that could then be used to augment the credibility of the findings. The study, being
a more shared project, involving three assistants, potentially could generate more data, supply more findings and enhance the professional development experience for participants.

To augment future research, a complete preliminary study to examine the Board, school and Department would be beneficial. Also, further detail could be realised when a follow-up study is complete. The impact would be greater depth and breadth of findings. In the follow-up study, contact with other school staff would be made to tease out and firm-up positions concerning the impact of the research on participants and school functioning. This would provide further opportunity to illuminate the degree of participant change perceived by all stakeholders. We would then be able to name and frame issues and problems more readily. With the help of on-site stakeholders, a record concerning future tasks could be assembled and made more readily available.

Improved research can be realised if participants are better informed, which increases initial awareness at the onset. A time of preliminary work may have assisted and facilitated our action research by providing more orientation and information concerning all facets of the project. Perhaps better research may have been possible with fewer participants, given the fact this was a relatively new role for each one of us. Also, I believe that the compatibility of the participants, and the fact that it was also a professional development aim for all staff at the school, contributed to our situation and success. Participants, whether they are from one school or many, need to be compatible at some
level and to have had some common experiences. Common experience and shared aspiration is the starting point for productive debate. Too much diversity can cause awkwardness, even suspicion, and can limit progress – especially in the early stages. Too much diversity can cause awkwardness (even suspicion) and limit progress. We were compatible because we shared so much and our level of trust with one-another, which is essential, allowed for more thorough sharing of ideas, understandings and questions. Next time I would plan to have fewer participants over a two-year period of study to see if our work has the impact hoped for. This would allow time for deeper and wider examination of each participant and possibly reduce the number of tasks for me. I could be in class more often and have more meetings with each participant that can only improve the chances of a better outcome.

Beginning this study I had a reasonably strong theoretical background yet I accelerated my learning by jumping into my roles (practice). I had many roles and I learned to fulfil these roles better via trial and error as time passed. My roles included that of a facilitator, recorder, critic, supporter and resource person, to name but a few. This diversity made the experience more intense and stressful as I had many new responsibilities. For example, as a facilitator I directed the group by choosing to supply feedback that was aimed at both support and growth. I did give some advice but only after it was solicited and we had discussed the issue thoroughly. My advice was often in the form of a story, as I found this approach more comfortable, and we often laughed at what
I had to say. Humour and being open seemed to help most. Telling a respectful joke or showing something funny (cartoon) could defuse a tense moment. Yet, I was careful to keep my input ‘appropriate’ and professionally related. When I did this my emotions came out and a sense of drama gripped us. Often my humorous stories took me to memories that had been hidden away for some time. It wasn’t work. I enjoyed it, and so did the participants as they often reciprocated. I was careful not to be too centre stage and often kept quiet in order to draw out participant input. With limited time during meetings I chose to focus and use assessment language in order to stay on task, motivate and to some extent encourage participants to adopt or contest. As a critic I put forward demanding questions and challenged participant beliefs and values. I would do this again, as I found all of these roles stimulating.

Putting together and pulling together the group were demanding tasks. Building positive relationships included confirming communications and being sensitive. Being an active listener while advising, judging, analysing and supporting demanded communications skills. Yet, my initial lack of awareness of participant relationships sometimes proved beneficial as I found it easier to share and expect sharing. As the study unfolded I could sense certain tensions and positions. I increased my listening skills and, as a result my communications, through trial and error. If I were to repeat this study I may choose participants in a different manner. This could increase or decrease the diversity of a group. Diversity is often a good trait in group work as it can
provoke communications, it can be a stimulus, yet too much may inhibit discussions and cause participants to drop-out of the project.

The issue of building relationships was ever present and challenging. Yet, since I was not from within I was able to move freely in and out of the department and school as a non-employee. At times I had to resolve interpersonal conflict which is natural given our close relationships. When tensions appear in the midst of your research it is very stressful due to the very high stakes. Such conflict could cause participants to drop out or sabotage the process. Choosing a conflict resolution style is difficult and, when you are a single facilitator you need to proceed in an informed manner. As noted earlier, I chose to be a humorous storyteller. Still, I could have used more insight in this area of conflict resolution. Tensions often brought us to new constructive realisations.

In future there is a need to approach action research not as a task to be completed in a certain amount of time but more as an on-going professional development experience that can bridge theory and practice in order to realise personal growth. After all, this inquiry was a means of illumination. It was a mode of professionalisation that impacted assessment and, ultimately, curriculum planning. In conclusion, more assistance, a preliminary study and a follow-up study would lead to better outcomes which would then enhance group cohesion and lessen turbulence for participants.
Chapter 12

Summary

This study has illuminated and generated some specific insights with respect to secondary science assessment praxes and action research as a model for effective professional development. This study brought to light several problematic aspects of teaching and teachers' practice and theory. First, there was a void in the education of teachers, which included a lack of preservice teacher training in assessment. As a result, there are questionable levels of teacher assessment literacy on which to build (Earl & Cousins, 1995).

Second, inservice educators have insufficient time and opportunity for the provision of good professional development and, with funding being reduced provincially and teaching time being increased, this dire situation may get worse. Third, teachers in this study did not have enough time to prepare or to meet with colleagues to critically reflect on teaching or instruction. This resulted in a sense of being overwhelmed, and generated a level of isolation that encouraged the perpetuation of traditional assessment means. There is simply no incentive for change. These assessment means are admittedly narrow, less creative and less stimulating for teachers and students than the varied and alternative means of assessment recently espoused by the expert panel reviewing secondary science, but teachers may well feel powerless to do anything else.

These observations and claims were a direct outcome of this 'practical' action
research effort. I listened to participants explain their assessment praxes. I learned of their values, beliefs, ideas and reflections over several months. During this time, our group met and produced over six hours of transcripts. Individual participants were also interviewed six times each, for a total of about three hours. Adding to the data were participant journals, documents, classroom visitation observations and notes from informal contact.

**Action Research and Interactive Professionalism**

We saw ourselves as a learning group (community) of educators, professionally developing our knowledge, skills and practice. We believed this perspective closely parallels Fullan's (1991, p. xiii) definition of interactive professionalism, which suggests:

- Teachers as a group are allowed greater powers of discretion in making decisions with and on behalf of the children they know best.
- Teachers make these decisions with colleagues in collaborative cultures of help and support.
- Joint teacher decisions extend beyond sharing of resources, ideas and other immediate practicalities to critically reflect on the purpose and value of what teachers teach and how.
- Teachers are committed to norms of continuous improvement in their school.
- Teachers are more fundamentally accountable as they open their classroom
doors and engage in dialogue, action and assessment of their work with other adults inside and outside their schools.

Within our study we worked to improve ourselves, to help students achieve more fairly and widely via new assessment schemes, and we were critical with one-another. Our level of commitment allowed us to work together collaboratively, and, because we made our values and beliefs known to one-another, we were ultimately being accountable via this sharing of our ideas and practices. Fullan (1991) further characterises interactive professionalism as "teachers and others working in small groups interacting frequently in the course of planning, testing new ideas, attempting to solve different problems, assessing effectiveness, and so on" (p. 120). Indeed, our inquiry involved interactive professionalism as we reflected, acted and revised assessment praxes and yet our study began as action research. It is my belief that our work contained the traits of interactive professionalism just as most action research efforts do. Earlier in our study, Section 3.3, I pointed out some of the differences.

To review, action research, as in this study, involves strategic action (McMahon, 1999) to help educators attain a high degree of specific interactions (interviews, group meetings, classroom observations, evidence collection), which may not be found in interactive professionalism. The interaction in action research is not intended to provide critical advice, as in interactive professionalism (Fullan, 1992). Rather, the type of interaction in most action
research efforts is aimed at supporting all participants as they plan, act, reflect, revise, and make public their intention to engage in research, over what is usually a set time period. It enables participants to provide their own critical advice! Unlike interactive professionalism, action research is systematic (Sagor, 1992) and involves a series of deliberate and planned intentions in order to solve a problem (McMahon, 1999). The results of such efforts are usually made public (published, presented). Interactive professionalism is more informal, casual, less methodical, and not usually made public outside the group of staff members. This research effort, which contained many of the traits included in interactive professionalism, was successful because we were systematic and used strategic actions to achieve our goals. This makes it action research.

Adding to our motivation and level of commitment to achieve such action research goals was the fact that our group of professional educators acted voluntarily, free of administrative manipulation or pressure. Each participant was free to influence the pace, direction and extent of any changes that might be made. Participant freedom of this kind is a key feature of action research and is in sharp contrast to the top-down directive policy of the Ontario Ministry of Education and Training which can be enormously debilitating because teachers feel a loss of control over their professional practice. Action research overcomes this feeling through empowerment as teachers’ sense of ownership increases via a supportive and nurturing collegial effort.
Meeting Obstacles: Time, Isolation and a Strike

Recurring themes included both time and isolation, each of which is well documented in the educational literature. Isolation can be synonymous with privatism (Fullan, 1991) or compartmentalisation (Earl & Cousins, 1995). This isolation (Woods, 1993) can be an obstacle to action research, which is often dependent for its success upon collaboration. It can also, of course, be an obstacle to good teaching and assessment. If participants in this study were isolated, it was simply a feature of their organisational structure, the secondary school. This isolation appeared to narrow the scope of their teaching, making it more traditional, less creative and less satisfying. This was due in part to the system, which was controlled by time (periods, terms, semesters), and not by issues of learning. It is a system that prioritises content coverage over understanding. This need to cover content in a certain amount of time causes stress as teachers struggle to fit in the curricular content with little time for professional development, or simply talking with colleagues. This predicament results in a general lack of time or thought directed towards student achievement, assessment theory or practice.

In our study, participants committed themselves to open and honest communications that were enlightening and motivating, and nurtured professional development of assessment praxes. Participants rarely missed an opportunity to meet and enter into discussion. Our collaborative discussions
allowed for reflection and this was viewed as essential to developing
assessment literacy, enhancing theoretical understanding and transforming
praxes. Earl and Cousins (1995) add:

If teachers are going to work together to reconfigure assessment . . . practices, they will not only need staff development, and lots of it, but they will need help to overcome all of the constraints of overload, isolation, and compartmentalisation that are endemic to schools. (p. 42)

Overload, a feature of limited time, was an ever-present obstacle. All participants wanted and needed more time to act on the emergent ideas; thoughts and theories brought out via illumination of assessment praxes. But none was available, unless we met before or after school. We chose mornings, when each of us would be most energetic. As well, participants wanted more time to respond to the multiple demands of teaching, but Bill 160 was aiming to reduce preparation time. Preparation time is much too scarce, now, whether it is for classes or professional learning (Hargreaves & Fullan 1998). The group concluded that further erosion of preparation time would prove deleterious to the profession.

One of the largest threats in the 1997-1998 school year, that had an undeniable impact on curriculum, assessment praxes and morale, was the two week strike by Ontario teachers over Bill 160. This event shortened time lines even further and created anxiety for teachers, students, stakeholders and this facilitator as there was generally less time to complete anything (courses,
teaching, our study). Participants in this study agreed that much of this study was affected by the event. At several points, after the strike, participants reflected on their behaviour and apologised. They attributed blame for their behaviour to the strike, yet I was not aware of the extent of the problem. There were a few incidents of questionable motivation, when a meeting was missed or a journal was handed in without notations. However, these were not immediately attributed to the strike until I was made aware of the connection by those affected most, my participants. I assumed that some changes in our schedule were to be expected in a group research effort such as this one. As the inquiry progressed, we acknowledged that our group lacked formal training and teacher preparation in the area of assessment. We lacked professional development opportunities, except for myself. We lacked sufficient time to pursue all our needs, which was no surprise. As with any inquiry that seeks to illuminate and find a better way, there are new questions. The new questions, if placed within our data matrix (Appendix H), are mostly located in the 'how' of assessment praxes. For instance, given our current schedules and educational structure: How can we find the time and energy to create and deploy new assessment tools, such as the portfolio, peer and self-assessments and journals? Second, how can we change from a content driven curriculum to one that is achievement oriented, given the new science curriculum soon to be released? Third, with the reduction of preparation times, a new 'rigorous' science curriculum, and the continued interference of bureaucratic bodies in the form of Bill 160 and provincial government
legislation that dictates more teaching time, along with back to work legislation and Board lock-outs, how can teachers assess effectively? Action research seemed to offer me a means to effectively meet and/or challenge some of those obstacles.

**Success via Action Research**

The apparent 'success' of this study can be attributed to three features: a dedicated group of participants, supportive Board of Education, and encouraging school administration. This study benefited from the shared support of stakeholders. Rosaen and Schram (1997) add: "A shared inquiry could take advantage of different strengths brought by novices, experienced teachers, and teacher educators, and create opportunities to work toward common ends . . ." (p. 277). Our inquiry brought together a first year teacher, three experienced teachers and a veteran teacher educator (myself). Our perspectives were different, as were our experiences. The contrasts seemed to produce, support and nurture new insights. For instance having a first year teacher in our group seemed to enrich our experience. To have a person unaffected and new to the profession question the theory and practice of secondary science education in the midst of experienced teachers creates a powerful stimulus. They often ask those very penetrating naive questions that make the rest of us sit-up and say "Yes, why do we do that?" In other words, what has become familiar to others is examined more carefully because of their presence. Our construction of new insights was really an outgrowth of the
heterogeneous group. This growth was encouraged first by the Board's actions to permit this study and then welcomed via my presentation at a science curriculum council at the Board Office. Similarly, at the school level, I was permitted entrance and each participant was then supported via acknowledgement at staff meetings. Further, I presented our study at a staff meeting of Department Heads.

Even though this action research has ended, a number of lingering issues remain. If teachers do remain passive, then we will have a continuing crisis in Ontario education. Yet, I believe that teachers will rise up, using (perhaps) action research as a means to study questions and respond to governmental claims. Hargreaves and Fullan (1998) add: "It is hard to see how teaching can become a more vigorous learning profession unless teachers together take . . . more control over their own learning agenda. Otherwise, professional development degenerates into one-shot workshops on the latest government or district policy " (p. 84). Action research is well placed as a teacher-as-researcher mode of inquiry that can produce the needed responses, insights and claims to contrast with the government's positions. Indeed, these action research insights allow us to put forward a perspective that is, at times, very different from the government's presentation.

12.1 Implications of this Study

This study has, to some extent, shown that secondary science teachers can
enter into action research commitments. These commitments led to limited improvement and growth within resultant modes of assessment praxis. Participants have begun to understand how to act, reflect and revise, all of which are essential to revitalise practice. Critical reflection, a centrepiece of action research, is a useful tool for future inquiries involving individuals or groups of educators. By participating in action research, learning occurs, improvement is cultivated and professionalism is enhanced. This study has demonstrated that it is possible to support action research participants as they develop professionally.

12.2 Future Directions: Tasks and Role of Action Research

Action research is truly a teacher-researcher friendly mode of inquiry that can be widely used in preservice teacher education and inservice professional development efforts. Educational leaders such as Hargreaves and Fullan (1998), Hodson (1994), and Pedretti (1994, 1996) have pointed to the many benefits of action research as a means of improving practice. It is a means to examine and self-monitor. By entering into an action research commitment, teachers can build a perspective with others and provide insight that is validated by participants. For example, this research experience taught participants that they can find common meeting times to discuss theory and practice in spite of reduced preparation time, busy schedules and increased workload. In doing so, participants support and nurture one another
professionally, while improving their own praxis. Often issues related to individualism, autocracy, and isolation can be introduced, reflected upon and dealt with in this forum.

Admittedly, teachers can always improve since teaching is something that is never mastered. It is intrinsically challenging each day. Educational questions and educational contexts are too complex, uncertain and dynamic to be easily or finally answered. Indeed, one of the ideological commitments of the action researcher is that nothing is ever settled/answered/solved. As a next step it seems natural to suggest that participants meet with other teachers to act, reflect and revise in order to improve their situations professionally and personally. Perhaps teacher performance appraisals (which are mandated) can be supported and augmented by these processes. The action research process provides a personal approach to both self and peer-appraisals in order to inform administration and other stakeholders about issues such as accountability. It becomes a radically different and professionally enhancing notion of accountability that could replace the current emphasis on prescription and control. Indeed, there is no area of education that cannot benefit from this mode of inquiry. Action research can be used to nurture an individual, a group, a school or an entire Board (Altrichter et al. 1993; Hopkins, 1993, Russell, 1995).

In this study participants agreed that action research can reduce individualism,
and isolation. Action research also promotes professional development and enriches educators at any point in their career. Indeed, upon becoming a member of a community of educators, each participant is empowered to initiate change and transform some aspect of their praxis. Hence, action research can then be a means to respond to government studies, claims and other theories put forward by stakeholders. In doing so, action research is used as a tool to increase professionalism and empower teachers to combat the adverse publicity that teachers receive from the media (press).
REFERENCES


Ontario Teachers Federation (September 29, 1997) *Submission of the Ontario teacher's federation to the standing committee on the administration of justice on Bill 160, The Education Quality Improvement Act.* (on-line), 1 - 17.


Secondary Science Curriculum
Guideline: Listing

Science

Science, Intermediate and Senior Divisions, Part 1:
Program Outline and Policy, 1987

Science, Intermediate and Senior Divisions, Part 2:
Science (Grades 7 and 8), 1987

Science, Intermediate and Senior Divisions, Part 3:
Science (Grades 9 and 10, General Level), 1987

Science, Intermediate and Senior Divisions, Part 4:
Science (Grades 9 and 10, Advanced Level), 1987

Science, Intermediate and Senior Divisions, Part 5:
Science (Grades 9 and 10, Basic Level), 1987

Science, Intermediate and Senior Divisions, Part 6:
Science (Grades 11 and 12, Basic Level), 1988

Science, Intermediate and Senior Divisions, Part 7:
Environmental Science (Grades 10 and 12, General Level), 1988

Science, Intermediate and Senior Divisions, Part 8:
Environmental Science (Grades 10 and 12, Advanced Level), 1988

Science, Intermediate and Senior Divisions, Part 9:
Applied Biology and Applied Chemistry (Grade 11, General Level), 1988

Science, Intermediate and Senior Divisions, Part 10:
Applied Physics and Technological Science (Grade 12, General Level), 1989

Science, Intermediate and Senior Divisions, Part 11:
Geology (Grade 12, General and Advanced Levels), 1988

Science, Intermediate and Senior Divisions, Part 12:
Biology (Grade 11, Advanced Level, and the OAC), 1987

Science, Intermediate and Senior Divisions, Part 13:
Chemistry (Grade 11, Advanced Level, and the OAC), 1987

Science, Intermediate and Senior Divisions, Part 14:
Physics (Grade 12, Advanced Level, and the OAC), 1988

Science, Intermediate and Senior Divisions, Part 15:
Science in Society (OAC), 1988
APPENDIX B

An Action Research Model

Stringer (1996)
APPENDIX C

Aide Memoire - (list of topics)

Interview 1

Assessment Beliefs - Assessment Development - Assessment Targets
Assessment Methods - Assessment Validity - Judging Appropriateness
Collection of Assessment Data - Interpretation of Data - Judgement of Data

Assessment Consequences - Assessment Decisions - Assessment Bias
Assessment Discrimination - Assessment and ESL
Assessment Purpose Explanations

Assessment Conditions
(light, temperature, time, comfort)
Assessment Realism - (components vs time)
Assessment Communications - (directions, understanding)
Assessment Appropriateness - (age, grade, level, ability)

Assessment Standards - (criteria, clarity) Assessment Penalty - (use)
Assessment Information Collection - (fairness)
Assessment Nuances - (fire drill, special event)
Assessment Policy - (written, agreed to) Assessment Special Needs

Scoring Methods - Assessment Encouragement - (motivation)
Assessment Pooling (raters, consistencies) Assessment Feedback (student comprehension)
Assessment Monitoring (errors & corrections in methods)
6
Assessment Appeals
(policy, process)

Assessment Written Policy
(reporting, summarization)

Assessment Interpretation
(parents, students)

Assessment Diversity
(social, emotional, physical)

Assessment Weighting
(justification)

Assessment Confidentiality
(data, records)

7
Assessment Limitations
(error)

Assessment Guidelines
(Ministry of Education)

Assessment Balance
(Strengths vs Weaknesses)

Assessment Conferences
(frequency)

Addendum

Assessment Access
(parents, others)

Assessment Transferral
(School to School)

APPENDIX D

Guidelines for Conducting Interviews

(1) You should document the interview unobtrusively. Some of the procedures for documenting data described at the start of this chapter may be used if appropriate to the situation, such as the use of notebooks, audiotape and videotape recording. Always let your interviewee know that you are doing this.

(2) You should be clear about the ethics of interviewing which are similar to those for all forms of research.
   - Tell your interviewees what the interview is about, or tell them that you are unable to do so.
   - Do not mislead or deceive people in order to get them to impart information.
   - Be prepared to maintain complete confidentiality if this is requested.

(3) You should develop listening skills. Active listening includes controlling your body language to communicate that you are interested in and value what is said.

(4) You need to give verbal clues to encourage your interviewee to talk freely.

(5) You need to play back what the interviewees say in order to help them maintain their flow. For example, you might say, 'Now, as I understand it, you are saying you were a victim of bullying at school.'

(6) You need to show that you empathize with your respondents' positions so that they expand what they are saying.

(7) You need to be able to accept silences because they are important spaces in which speakers gather their thoughts or harness their courage.

(8) Get some practice in using possible 'framing questions' that help to keep the conversation going. For example:

**Clarifying questions** to clarify something that the speaker has said:
'Can I check that, please?'

**Probing questions** to explore an issue that the speaker has raised:
'Can we discuss that a little further?'

**Context-specific questions** that check (a) that the interviewee is at ease with the question: 'Is it all right for us to talk about this?', or (b) that the interviewee understands the question: 'Can I ask you to put that question in your own words?', or (c) that the interviewee is comfortable with your own performance: 'Have I said that correctly?'.

School Board
Assessment Documents

SECONDARY SCHOOLS

Principles of Assessment and Evaluation

1. Assessment and evaluation relate directly to the achievement of learning expectations as stated in OSIS and Ministry Curriculum Documents and is the responsibility of the teacher.

2. Assessment and evaluation should respect and enhance the students' individual rights and dignity.

3. Assessment and evaluation of student learning should include a wide variety of strategies and methods.

4. Assessment and evaluation are learner focused and should involve the active participation of students.

5. Assessment and evaluation practices reflect current research and knowledge about learning and teaching.

6. Assessment and evaluation should provide feedback to the learner and support further learning and teaching.

7. Assessment and evaluation emphasize those aspects and components of learning which are valued.
Principles of Assessment and Evaluation

1. Assessment and evaluation relate directly to the achievement of learning expectations as stated in OSIS and Ministry Curriculum Documents and are the responsibility of the teacher.

Assessment and evaluation strategies are clearly outlined, along with learning experiences and support activities in the Course Outline.

Information gathered from assessment is used as the basis for developing new curriculum experiences and learning opportunities.

Learning experiences provide opportunities for inquiry, problem solving, critical thinking and the application of skills, knowledge and Catholic values.

Continuous record keeping of student performance is required.

2. Assessment and evaluation should respect and enhance the students' individual rights and dignity.

Assessment and evaluation are based on identifying each student's strengths and progress and supporting the student in developing and improving skills.

All evaluation statements are based on concrete evidence.

Standards for evaluation are shared from the beginning.

Through assessment and evaluation the gifts of the learner will be recognized.
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| **3.** Assessment and evaluation of student learning should include a wide variety of strategies and methods. | **More than one assessment activity should be used to ensure a comprehensive evaluation.**

All students are given sufficient and varied opportunities to demonstrate knowledge, application of skills, abilities and values

Assessment and evaluation samples, products or materials are used as evidence of learning.

---|
| **4.** Assessment and evaluation are learner focussed and should involve the active participation of students. | **Students are given authentic opportunities to use higher order thinking, apply knowledge, solve realistic problems and make connections.**

Assessment must reflect the learning that has occurred.

---|
| **5.** Assessment and evaluation practices reflect current research and knowledge about learning and teaching. | **Assessment and evaluation strategies are tailored to the individual needs of students within the parameters of course expectations.**

Methods of assessing learning are planned as learning experiences in the curriculum and should be indistinguishable from the learning process.

Assessment and evaluation are reviewed on a regular basis and incorporate new methods where appropriate.
6. Assessment and evaluation should provide feedback to the learner and support further learning and teaching.

Course outlines include assessment and evaluation practices designed to support further learning.

On-going assessment reflects both process and product.

Assessment and evaluation samples, products or materials are used as evidence of learning.

Information gathered through assessment and evaluation should assist students and their parents in making decisions regarding the future.

7. Assessment and evaluation emphasize those aspects and components of learning which are most valued.

Catholic values should be inherent to the assessment and evaluation process.

Process and product are equally valued and are reflected in assessment and evaluation.

The processes, strategies and qualities of learning such as risk-taking are valued and reflected in assessment and evaluation.

<table>
<thead>
<tr>
<th>Curriculum Area</th>
<th>Goal</th>
<th>Leadership</th>
<th>Activities</th>
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<tr>
<td>1. Infusion of Catholic Values</td>
<td>Apply the Gospel values to all subject areas of the curriculum. Mandate a Planning Model to be used for curriculum development in all secondary schools</td>
<td>Principals/Vice-Principals</td>
<td>a) Workshop for Vice-Principals</td>
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<td></td>
<td>b) Curriculum Council meetings</td>
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<td></td>
<td>c) Staff in-service</td>
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<tr>
<td>2. Assessment and Evaluation</td>
<td>Apply the Principles of Assessment and Evaluation for Board secondary schools to best practice in classrooms</td>
<td>Chairs/Advisors</td>
<td>a) Workshops</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>b) Curriculum Council meetings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>c) Department in-service</td>
</tr>
<tr>
<td>3. Computer Technology in the Curriculum</td>
<td>Course outlines will include computer technology component</td>
<td>Chairs/Advisors</td>
<td>a) Workshops</td>
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<td></td>
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<td></td>
<td>b) In-service P.D.</td>
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<td></td>
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<td></td>
<td>c) S4G</td>
</tr>
<tr>
<td>4. Preparations for Secondary School Reform</td>
<td>All staff will become knowledgeable regarding Secondary School Reforms as announced by MET</td>
<td>Principals</td>
<td>School-based Workshops</td>
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## APPENDIX F
### Schedule of Action Research

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<tr>
<td>27 28 29 30 31</td>
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</tbody>
</table>

**October**

- 8:00 AM - 8:30 AM Group Discussion
  - 8:15 AM - 8:45 AM C.M.: Interview
  - 10:30 AM - 11:00 AM Bred M.: Interview
  - 12:45 PM - 1:15 PM J.A.: Interview
  - 2:15 PM - 2:45 PM C.A.: Interview
- Consent Forms - Signed

- 15 8:00 AM - 8:30 AM Group Discussion
- 28 8:00 AM - 8:45 AM Group Discussion
- 29 8:45 AM - 9:00 PM Ontario Teachers Strike

**November 97**

- MTWFS | 1 2 |
| 3 4 5 6 7 8 9 |
| 10 11 12 13 14 15 16 |
| 17 18 19 20 21 22 23 |
| 24 25 26 27 28 29 30 |

**November**

- 5 8:45 AM - 9:00 PM Ontario Teachers Strike
- 12 8:00 AM - 8:30 AM Group Discussion

**December 97**

- MTWFS | 1 2 3 4 5 6 7 |
| 8 9 10 11 12 13 14 |
| 15 16 17 18 19 20 21 |
| 22 23 24 25 26 27 28 |
| 29 30 31 |

**December**

- 27 8:00 AM - 8:30 AM Group Discussion

**January 98**

- MTWFS | 1 2 3 4 |
| 5 6 7 8 9 10 11 |
| 12 13 14 15 16 17 18 |
| 19 20 21 22 23 24 25 |
| 26 27 28 29 30 31 |

**January**

- 7 8:15 AM - 8:45 AM C.M.: Interview
- 10:30 AM - 11:00 AM C.A.: Class Visit
- 12:45 PM - 1:15 PM P.A. Class Visit

**February 98**

- MTWFS | 1 2 3 4 5 6 7 8 |
| 9 10 11 12 13 14 15 |
| 16 17 18 19 20 21 22 |
| 23 24 25 26 27 28 29 |

**February**

- 14 8:00 AM - 8:30 AM Group Discussion
- 22 8:00 AM - 8:30 AM Group Discussion

**March 98**

- MTWFS | 1 2 3 4 5 6 7 8 |
| 9 10 11 12 13 14 15 |
| 16 17 18 19 20 21 22 |
| 23 24 25 26 27 28 29 |

**March**

- 11 8:15 AM - 8:45 AM C.M.: Interview
- 10:30 AM - 11:00 AM Bred M.: Interview
- 12:15 PM - 2:45 PM J.A.: Interview

**April 98**

- MTWFS | 1 2 3 4 5 6 7 8 |
| 9 10 11 12 13 14 15 16 |
| 17 18 19 20 21 22 23 24 |
| 25 26 27 28 29 30 31 |

**April**

- 8 2:15 PM - 4:15 PM C.A. Interview
- 9 8:00 AM - 8:30 AM Group Discussion

**May 98**

- MTWFS | 1 2 3 |
| 4 5 6 7 8 9 10 |
| 11 12 13 14 15 16 17 |
| 18 19 20 21 22 23 24 |
| 25 26 27 28 29 30 31 |

**May**

- 15 8:15 AM - 8:45 AM C.M.: Interview

**June 98**

- MTWFS | 1 2 3 4 5 6 7 |
| 8 9 10 11 12 13 14 |
| 15 16 17 18 19 20 21 |
| 22 23 24 25 26 27 28 |
| 29 30 |

**June**

- 16 8:00 AM - 8:30 AM Group Discussion

**July 98**

- MTWFS | 1 2 3 4 5 6 7 |
| 8 9 10 11 12 13 14 |
| 15 16 17 18 19 20 21 |
| 22 23 24 25 26 27 28 |
| 29 30 31 |

**July**

- 17 8:15 AM - 8:45 AM C.A. Class Visit
- 10:30 AM - 11:00 AM C.A. Class Visit
- 12:45 PM - 1:30 PM P.A. Class Visit

**August 98**

- MTWFS | 1 2 3 4 5 |
| 6 7 8 9 10 11 12 |
| 13 14 15 16 17 18 19 |
| 20 21 22 23 24 25 26 |
| 27 28 29 30 31 |

**August**

- 14 8:00 AM - 8:30 AM Group Discussion

**September 98**

- MTWFS | 1 2 3 4 5 6 |
| 7 8 9 10 11 12 13 |
| 14 15 16 17 18 19 20 |
| 21 22 23 24 25 26 27 |
APPENDIX G

ETHICAL REVIEW FORMS:

Ethical Review: Statement of Intent
Ethical Review Protocol (4 pp.)
Ethical Certificate (1 p.)
Statement from Committee Members (3 pp.)

Ethical Review:

Statement of Intent for Student Theses and Projects

Title of Thesis/Project:

Student and Faculty Supervisor:

Department:

An Ethical Review must be completed for each study which involves human subjects. Such a study involves the gathering of data through direct or indirect-contact with people where the data can have an impact on their lives. Studies which do not involve the use of data collected from/on human subjects, or which involve the use of data collected from/on human subjects where such data are in the public domain, do not require a full ethical review.

Please indicate by a checkmark below, the category into which the proposal fits. Students whose studies require an ethical review must complete an Ethical Review Protocol and complete the review with the help of their supervisor. Those students whose studies do not require full ethical review should complete and sign this form (along with their thesis supervisor), give it to the appropriate Department Chairperson for signature and then take or send it to the OLSE Graduate Studies Office.

[ ] This study does not involve data collection from/on human subjects.
(No Ethical Review required; Ethical Review Protocol not required).

[ ] This study involves the analysis of data obtained from/on human subjects where such data are in the public domain.
(No Ethical Review required; Ethical Review Protocol not required).

[ ] This study involves the analysis of data obtained from/on human subjects where such data are not in the public domain. (Ethical Review required; Ethical Review Protocol must be completed.)

[ ] This study involves data collection from/on human subjects.
(Ethical Review required; Ethical Review Protocol must be completed.)

[ ] This study involves the collection/analysis of data obtained from/on human subjects where an ethical review has been completed for a larger research project at another institution.
(Ethical Review not required; a copy of the Ethical Review Certificate of Completion must be attached.)

Signature of Student

Signature of Faculty Supervisor

Signature of Department Chairperson to indicate agreement if no Ethical Review is required.
Ethical Review Protocol

To be completed by Principal Investigators for all studies which

- involve the use of human subjects, and/or
- involve the analysis of data collected from/on human subjects where such data are not in the public domain.

Title of Project/Thesis:

Principal Investigator(s) or Student and Faculty Supervisor:

Department in which project/thesis will be housed:

Objectives of Study:

1. Data Collection

(a) What data are being collected? (achievement scores, attitude scores, experimental test results, etc.)

(b) How will the data be collected? (Survey, questionnaire, structured interviews, observation, participant observation)
(c) Procedures: Please outline procedures to be followed in (a) and (b) above.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(d) Instruments: Please list all questionnaires, tests, observation schedules, interview schedules, etc. to be used. Attach copies where possible.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(e) Indicate what information will be taken from existing records (e.g. school records, hospital records).

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(f) Curriculum Materials: Where the study involves field testing of curriculum materials, please describe the materials (i.e. the substantive content) which are to be developed and tested.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

2. Subjects

(a) Describe the subject population and give the age/grade level and the affiliation as appropriate (e.g. school, university/college students, school board employees, hospital employees, members of the public). Indicate the number of subjects to be included in the study.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(b) How will the subjects be selected for inclusion in the study?
3. Data Access, Uses and Interpretation

(a) Who will have access to the raw data?

(b) How will confidentiality and/or anonymity of the raw data be maintained? (e.g. will names be deleted and replaced by codes known only to the investigators; will data be stored in locked files?)

(c) What disposition will be made of the raw data at the end of the study? (e.g. to be stored in data archives).

(d) What feedback will be given to subjects and/or to those individuals who provided informed or administrative consent?

(e) What steps will be taken to maintain anonymity of subjects and test sites in written reports?

(f) What steps will be taken to alert participants to possible evaluative interpretation and to give them an opportunity to withdraw from the study? (By evaluative interpretation is meant, for example, the indirect evaluation of a teacher's professional performance or of a student's academic performance, as the result of participating in the study, where such evaluation is not an objective of the study).
4. Informed Consent*

(a) Will informed consent be obtained from all participants?
Yes _____ No _____

(b) Will administrative consent be obtained?
Yes _____ No _____

(c) What steps will be taken to obtain individual informed consent and/or administrative consent?

(d) Will the informed consent be written? Yes _____ No _____
If not, why not?

(e) What information will be given to subjects and/or others who are providing informed consent? Please attach a copy of each letter to be sent to potential participants. This letter should describe the study in lay terms, outline potential benefits/risks to participants, indicate that participants are free to withdraw at any time, outline what safeguards will be taken to maintain the confidentiality of the data and to protect participants from possible evaluation on the basis of the written report.

*Administrative Consent

Administrative consent may be deemed sufficient:

a) for studies which have as their intent and focus the acquisition of statistical information and where the collection of data presents

   (i) no invasion of personal privacy;

   (ii) no potential social or emotional risk;

b) for studies which have as their intent and focus the development and evaluation of curriculum materials, resources, guidelines, test items and program evaluation rather than the observation and evaluation of persons as individuals.

Signature of investigator(s) ___________________________ Date ____________
or ___________________________
Student and Faculty Supervisor
ETHICAL CERTIFICATE

Project/Thesis Title: ____________________________________________

Principal Investigator (if Research)
Student and Faculty Supervisor
(if Project/Thesis):

Ethical Review Committee Members:

Chair
________________________________________
________________________________________

This certificate is completed in the light of relevant OISE policy on legal, ethical and moral review, taking into account the relevant standards of the discipline concerned as well as, where appropriate, the standards specified by certain external funding bodies.

This is to certify that the above noted committee has examined this research and development project and concludes that the research meets the accepted professional standards for the conduct of research prevailing within the discipline(s) involved including appropriate standards of ethical acceptability.

________________________________________  _______________________________________
Signature of Chairperson                      Date
Ethical Review Committee

Except that the following additional measures must be taken to ensure conformity with such standards. (Please specify and indicate if further review is required).

________________________________________  _______________________________________
Signature of Chairperson                      Date
Ethical Review Committee
ETHICAL REVIEW: STATEMENT FROM COMMITTEE MEMBERS

Title of Project/Thesis: ________________________________________________________________
__________________________________________________________

Principal Investigators (if Research)
Student and Faculty Supervisor
(if Project/Thesis): ________________________________________________________________

1. Does this study present any risks for subjects/participants?

   Yes ____  No ____  If yes, please outline the nature of the risks.
   __________________________________________________________
   __________________________________________________________  
   __________________________________________________________  
   __________________________________________________________  
   __________________________________________________________  
   __________________________________________________________

2. Is the risk justified in terms of the potential benefits of the study?

   Yes ____  No ____  (If no, the project must be rejected).

3. Does the study involve procedures which may result in the invasion of the personal privacy of the participants/subjects?

   Yes ____  No ____

   IF THE PROPOSED STUDY INVOLVES ANY POTENTIAL RISKS AND/OR ANY POSSIBLE INVASION OF PRIVACY, THE INFORMED CONSENT OF PARTICIPANTS MUST BE OBTAINED.

4. What type of consent does the researcher intend to obtain?

   ___ individual, informed consent
   ___ administrative consent
   ___ individual consent not necessary.

   Is this adequate? Yes ____  No ____

   If No, what level of consent should be obtained?
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
5. Has the researcher provided adequate information on the procedures to be used in obtaining consent?

Yes ___  No ___

If No, what additional information is required?

__________________________________________________________________________

__________________________________________________________________________

6. Are the procedures for obtaining consent acceptable and do they adequately protect the rights of the subject?

Yes ___  No ___

If No, please indicate what changes to the procedure should be included.

__________________________________________________________________________

__________________________________________________________________________

7. Is the information to be given to those providing informed consent sufficient?

Yes ___  No ___

If No, please specify what additional information should be provided for subjects.

[Note: In order to provide informed consent, potential subjects should be given information on the nature of study, the potential risks/benefits of participation, the safeguards to be taken to maintain confidentiality of data and to protect participants from possible evaluation and should be advised that they are free to withdraw from the study at any time.]

__________________________________________________________________________

__________________________________________________________________________

8. Please outline any additional safeguards which should be introduced.

__________________________________________________________________________

__________________________________________________________________________
9. Is an additional review necessary to verify that the revisions you have requested in Questions 4, 5, 6 and 7 or the additional safeguards outlined in question 8, have been introduced?

No _____  Yes _____

If Yes, please indicate when this review should take place.

Prior to initiation of study ____

Other (please specify) __________

10. If the nature of this study is such that research instruments (e.g. questionnaires) and/or research materials (e.g. curriculum materials) will be developed during the course of the project, should an ethical review be undertaken prior to use of the instrument and/or materials with subjects?

No _____  Yes _____

If yes, please indicate which instruments/materials should be forwarded to the Ethical Review Committee and at what stage of the project.

_________________________________________________________

_________________________________________________________

_________________________________________________________

11. In your opinion does this proposed study present any unusual risk for the researcher or for the Institute. Please specify.

_________________________________________________________

_________________________________________________________

_________________________________________________________

_________________________________________________________

_________________________________________________________

Signature of Committee Member

Name (please print) Date

3
# APPENDIX H

Action Research - Assessment Praxes - Data Matrix

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<th></th>
<th>What</th>
<th>Why</th>
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APPENDIX I

Principal

School

Toronto, Ontario

September 4th, 1997

Dear Principal:

I am inviting your school and 4 science staff to participate in an Action Research project. My project is being conducted within the Department of Curriculum, Teaching, and Learning at the Ontario Institute for Studies in Education from September 1997 to April 1998. My research project will be submitted as partial fulfillment of the requirements of the degree of Doctor of Education at the University of Toronto. By agreeing to participate in the Action Research project we will be able to explore issues and practices in assessment within science while working collaboratively as an Action Research group.

The Project

Each of the 4 participants of the project will be invited to discuss and plan meetings, critically reflect on practices, plan and design alternative curriculum materials and practices within this supportive group. We can implement developed materials in class, evaluate these in action, and share with others, our experiences, feelings, and ideas as a way of informing and guiding our group’s professional development.

Data Collection

Data will be collected by tape-recording group meetings and field notes. Individual interviews will be held during the year with each participant. The recorded information will be transcribed and copies made available to the same teacher. I will be visiting participants classrooms upon their agreement. Information collected will be shared with that teacher only. Visits are necessary to promote understanding and promote professional development.

Participants will be encouraged to keep a journal. Teachers are asked to note assessment reflections, decisions, practices, habits and rituals that they use in classes. Beliefs about assessment can be written as can general thoughts concerning assessment theory and practice in science. I will be keeping a
journal also. The information collected in the journals are important to the action research process.

Ethics

All work will be anonymous and confidential. All names will be changed as will details that may reveal the identity of the participant. Only the field notes, interview transcripts, and journals will be seen by my thesis committee. All tapes and journals will be secured once the project is completed. Your consent will be necessary if any publication of this data is possible.

The project seeks to study teachers as they collaborate while participating in an Action Research Project in science. The actions of non-participants may appear only for background context. If student input is necessary permission will be given first by administration, teachers, and parents.

Findings and conclusions will be shared with participants and careful interpretations will be recorded as the project moves forward. An editing process will be used which is helpful and important. Our aim is to present an accurate, fair, and agreed upon account of experiences. If agreement is not reached both accounts will be written into the data. Participants may delete any text and a final summary will be provided.

Note: All have the right to withdraw at any point without reason.

If you are willing to participate in this research project, please complete the attached form. Thank-you for your support and co-operation in this Action Research Professional Development Process.

Respectfully,

Thom Ryan

Department of Curriculum, Teaching, and Learning (CTL)
OISE\UT

I can be reached at 326-2811
PRINCIPAL CONSENT FORM

I, ________________________________ agree to allow my staff to participate in the study entitled: An Action Research Study of Secondary Science Assessment Praxes, as outlined in the attached letter.

Signature ________________________________

Date ________________________________

Researcher ________________________________
Dear Participating Teacher:

I invite you to join me and others on your staff to take part in a research project, conducted within the Department of Curriculum, Teaching, and Learning at the Ontario Institute for Studies in Education from September 1997 to April 1998. This research project will be submitted as partial fulfilment of the requirements of the degree of Doctor of Education at the University of Toronto. By agreeing to participate in the Action Research project we will be able to explore issues and practices in assessment within science while working collaboratively as an Action Research group.

The Project

As a participant of the project you will be invited to discuss and plan meetings, critically reflect on your practices, plan and design alternative curriculum materials and practices within a supportive group of teachers. We can implement developed materials in your class, evaluate these in action, and share with others, our experiences, feelings, and ideas as a way of informing and guiding our group.

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Participants will be encouraged to keep a journal. Feel free to note assessment reflections, decisions, practices, habits and rituals that you use in your class. Beliefs about assessment can be written as can general thoughts concerning assessment theory and practice in science. I will be keeping a journal also. The information collected in the journals are important to the action research process.
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All work will be anonymous and confidential. All names will be changed as will details that may reveal the identity of the participant. Only the field notes, interview transcripts, and journals will be seen by my thesis committee. All tapes and journals will be secured once the project is completed. Your consent will be necessary if any publication of this data is possible.

The project seeks to study teachers as they collaborate while participating in an Action Research Project in science. The actions of non-participants may appear only for background context. If student input is necessary permission will be given first by parents, teachers, and administration.

Findings and conclusions will be shared with you and careful interpretations will be recorded as the project moves forward. Please read these accounts and respond as necessary with corrections and omissions or perhaps different understandings of the account. This editing process is helpful and important. Our aim is to present an accurate, fair, and agreed upon account of our experiences. If agreement is not reached both accounts will be written into the data. You may delete any text you feel uncomfortable with and a final summary will be given to you.

Note: You have the right to withdraw at any point without reason.

If you are willing to participate in this research project, please complete the attached form. Thank-you for your interest and co-operation.

Respectfully

Thom Ryan
APPENDIX K

Cal's Assessment Tools
Part A Multiple Choice (10 marks)

1. Under a light microscope the size of the objects seen is measured in:
   a) micrometres  b) centimetres  c) millimetres d) metres

2. A clear ruler marked in millimetres is being used to measure the size of a specimen under a light microscope. Four of the specimen would fit in one millimetre on the ruler. The size of the specimen is:
   a) 1000 um  b) 250 um  c) 2.5 cm  d) 25 um

3. In which of the following organelles is chromatin found?
   a) mitochondria  b) nucleus  c) vacuole  d) ribosome

4. Which of the following organelles is responsible for manufacturing protein in the cell?
   a) lysosomes  b) endoplasmic reticulum  c) ribosomes  d) golgi bodies

5. Osmosis occurs because:
   a) water is going from an area of low concentration to an area of high concentration
   b) water is going from an area of high concentration to an area of low concentration
   c) the pores in one direction block the water molecules and no water can get through
   d) none of the above

6. The asexual form of cell division is called:
   a) asexosis  b) mitosis  c) mitosis  d) none of the above

7. If veggies are placed in fresh water:
   a) their cells will be crisp and turgid because osmosis has occurred
   b) their cells will be limp and turgid because plasmolysis has occurred
   c) their cells will be crisp and flaccid because osmosis has occurred
   d) their cells will be limp and flaccid because plasmolysis has occurred

8. The structure in the plant cell that is made of cellulose is the:
   a) cell wall  b) nucleus  c) chloroplast  d) ribosome

9. Which of the following organelles contain chlorophyll?
   a) lysosomes  b) endoplasmic reticulum  c) chloroplasts  d) ribosomes

10. Organs that work together to perform large complex tasks are called:
    a) tissues  b) organs  c) organ systems  d) organisms
Part B Fill in the blanks (12 marks)

1. The magnification of a microscope can be determined by ________ the ________ and the ________.

2. When examining a sample of onion skin cells, the two most obvious structures are the ________ and the ________.

3. Two things that green plant cells have that animal cells do not have are ________ and ________.

4. ________ is the term used to describe a solution that has a higher concentration of water than the inside of the cell.

5. A(n) ________ allows all substances to pass through easily.

6. The field of view ________ as the magnification increases.

7. To initially bring the image into focus under low power, you turn the ________ . Under high power especially, you would use the ________ .

PART C - Cell Division

Place the letter of the correct stage of cell division in the space provided. Each stage may be used more than once.

M=Metaphase C=Cytokinesis T=Telophase
P=Prophase A=Anaphase I=Interphase

_____ The DNA replicates. _____ The chromosomes move to the centre.

_____ The nucleolus reappears. _____ The spindle fibres begin to form.

_____ A cleavage furrow develops. _____ The centrioles duplicate.

_____ The first stage of mitosis. _____ Where the cell spends most of its life.

_____ The spindle fibres shorten. _____ The chromatin become short and thick.

_____ The last stage of cell division. _____ Nuclear membrane disappears.

PART D - Extended Answer

1.a) List the levels of biological organization from simplest to most complex.

SIMPLEST

____________________

____________________

____________________

____________________

MOST COMPLEX

____________________

b) Why is it necessary for cells to become specialized?

________________________________________________________________________

________________________________________________________________________
2.) Why do grocers spray their vegetables with water? (Remember to use key terms in your explanation)

3.) A red blood cell is placed in pure water.
   a.) What type of solution is pure water?

   b.) Explain what will happen.

   b.) Name ONE of TWO things that other organisms possess so that they can survive in pure water.

4.) The cover is taken off a perfume bottle.
   a.) What will happen?

   b.) Explain why this will happen?

5.) In class we compared a cell to an industry. From this discussion, fill in the correct part of the cell for each role.

   manufacturing  __________  data center  __________

   executive offices  __________  packaging  __________

   corridors  __________  powerhouse  __________

6.) You found that the field of view under low power was 4 µm. When viewing a specimen, you estimated that 6 of them could fit across the field of view. What is the size of each specimen?

7.) You have determined the following data:

   low power field of view = 2 µm  low power magnification = 4x
   # of objects under high power = 10  high power magnification = 40x

   Calculate the size of one specimen under high power.
PART 1: Fill in the Blanks
Place the most appropriate word in the space provided. THE WORDS ARE PROVIDED AT THE BOTTOM OF THE QUESTION

1. A pure substance that cannot be broken down into simpler substances using ordinary chemical means is called a(n) _________________.

2. A ________________ represents the make-up or composition of a compound.

3. A ________________ is a mixture that is uniform throughout and has only one phase.

4. The ________________ is the substance that is dissolved in a solution (e.g. sugar).

5. The smallest part of an element is called a(n) ________________.

6. A substance that has the same composition throughout and that can be separated using ordinary chemical means is called a ________________.

7. The best way to separate a salt water solution is through ________________.

8. If a burning splint is placed in a test tube and a small "pop" can be heard, then the gas that is present must be ________________.

9. The substances that are undergoing a change in a chemical reaction are called the ________________.

10. The smallest part of a compound is called a ________________.

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>OXYGEN</th>
<th>SOLUTE</th>
<th>MOLECULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOLUTION</td>
<td>MAGNETIZATION</td>
<td>FORMULA</td>
<td>PRODUCTS</td>
</tr>
<tr>
<td>COMPOUND</td>
<td>REACTANTS</td>
<td>SOLVENT</td>
<td>ATOM</td>
</tr>
<tr>
<td>FILTRATION</td>
<td>HYDROGEN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PART 2: Short Answer Questions
Place all answers in the space provided.

1. List four factors that would tell you that a chemical reaction has occurred.
   a) __________ b) __________
   c) __________ d) __________

2. Name the following elements:
   a) N __________ b) Fe __________
   c) C __________ d) U __________
   e) Pb __________ f) Mg __________

3. Give the symbols for the following elements:
   a) potassium __________ b) sulphur __________
   c) oxygen __________ d) calcium __________
   e) helium __________ f) silver __________
4. Classify the following as physical or chemical changes:

- cracking an egg
- paper clip bending
- a bomb exploding
- kitchen scraps composting
- a firefly glowing
- dew forming on grass
- baking muffins
- sawing wood
- digesting food
- boiling water

5. Using the following flowchart, fill in the appropriate separation method that you would use.

sand, rocks, iron filings, antifreeze, sugar, water

```
  sand, rocks, iron filings
    |                     |
    v                     v
  sand, rocks            iron filings
  |               |               |
  v               v               v
  sand         rocks          iron filings
  |           |               |             |               |
  v       v       v       v       v       v
  sand   rocks
```

6. Complete the following chart:

<table>
<thead>
<tr>
<th>COMPOUND</th>
<th>NAME OF ELEMENTS PRESENT</th>
<th># OF ATOMS OF EACH ELEMENT PRESENT</th>
<th>TOTAL # OF ATOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na₂CO₃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₆H₁₂O₆</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KCl</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Write word equations for the following:

a) Table sugar reacts with liquid sulphuric acid to produce solid carbon, water vapour and sulphur dioxide gas.

b) Solid magnesium reacts with oxygen gas producing solid magnesium oxide.
8. Balance the following equations:
   a) $\text{Al} + \text{S} \quad \rightarrow \quad \text{Al}_2\text{S}_3$
   
   b) $\text{Fe} + \text{O}_2 \quad \rightarrow \quad \text{Fe}_2\text{O}_3$
   
   c) $\text{CaO} + \text{C} \quad \rightarrow \quad \text{CaC}_2 + \text{CO}_2$

9. Give the chemical test for TWO of the following:
   a) carbon dioxide gas
   b) hydrogen gas
   c) oxygen gas

10. MULTIPLE CHOICE : Circle the letter of the best answer in each of the following:
   1. Hydrogen is a(n):
      a) element  b) compound  c) solution  d) mechanical mixture
   2. Distilled water is best classified as a(n):
      a) element  b) compound  c) solution  d) mechanical mixture
   3. Sodium chloride is a(n):
      a) element  b) compound  c) solution  d) mechanical mixture
   4. Which of the following is a chemical change:
      a) wax melting  b) ice melting  c) food rotting  d) frost forming
   5. Which of the following is a compound:
      a) mercury  b) brass  c) silver  d) sugar

11. In a lab experiment, 23 grams of hydrogen peroxide was heated in a beaker so that it was broken down into water and oxygen. When the beaker was weighed after the experiment, it was found to weigh only 16 grams. These results do not follow the Law of Conservation of Matter. Explain what has happened.
GENERAL INSTRUCTIONS

1. Do not open this exam booklet until you have read these instructions and have been told by the presiding teacher to start the exam.

2. Count all of the pages carefully - you should have 4 pages in total. Notify the presiding teacher of any missing pages.

3. Read all questions carefully.

4. DO NOT WRITE ON THE EXAM BOOKLET except where and when requested.

5. Answer Sections A and B on the answer sheet at the end of the exam booklet.

6. Stay at your exam seat until the presiding teacher takes both this exam booklet and answer sheet from you.

7. Make all answers very clear.

8. Read "Part" instructions before proceeding to answer questions in each section.

Budget your time wisely - DO ALL QUESTIONS

<table>
<thead>
<tr>
<th>SECTION A - COMPLETE THE STATEMENTS</th>
<th>15 MARKS</th>
<th>15 MINUTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECTION B - TRUE OR FALSE</td>
<td>10 MARKS</td>
<td>5 MINUTES</td>
</tr>
<tr>
<td>SECTION C - MATCHING</td>
<td>8 MARKS</td>
<td>10 MINUTES</td>
</tr>
<tr>
<td>SECTION D - SHORT ANSWER</td>
<td>31 MARKS</td>
<td>30 MINUTES</td>
</tr>
<tr>
<td></td>
<td>64 MARKS</td>
<td>60 MINUTES</td>
</tr>
</tbody>
</table>
SECTION A: COMPLETE THE STATEMENT (15 marks)
From the list provided within the brackets, circle the word which best completes the following statements.

1. The (gram/ meter/ millilitre) is a unit used to measure mass.
2. Volume is the amount of (weight/space/air) occupied by matter.
3. (Energy/Matter/Density) is anything that has mass and occupies space.
4. An example of a chemical symbol would be (mm/H₂O/He)
5. (H₂/HCl/C) is not an example of a chemical formula.
6. (He/Li/NaCl) is an example of a compound.
7. An element consists of (one/two/three) type of atom(s).
8. Coffee and sugar is an example of a (pure substance/mixture).
9. Gold is an example of a (pure substance/mixture).
10. Homogeneous mixtures have (at least one/only one/more than one) visible phase.
11. A pizza would best be described as a (homogeneous/mechanical/heterogeneous) mixture.
12. The chemical symbol for helium is (H/He/H₂).
13. 'C' is the chemical symbol for the element (calcium/chlorine/carbon).
14. In order to change ice to water heat must be (conserved/added/removed).
15. (Cell membrane/nucleus/chloroplast) is an organelle not common to both plants and animals.

SECTION B: TRUE OR FALSE (10 MARKS)
If the following statement is true circle T, if it is false circle F.

T F 1. Osmosis is the diffusion of water molecules from an area of high concentration of water to an area of low concentration of water across a semi-permeable membrane.
T F 2. Iodine turning starch blue is an example of a physical change.
T F 3. A lake freezing over is an example of a chemical change.
T F 4. When you combine hot water and coco powder, the hot water is the solvent.
T F 5. Diffusion is the movement of particles from an area of low concentration to an area of high concentration.
T F 6. A cup of tea with sugar is an example of a solution.
T F 7. When you observe the letter 'p' under the microscope, its image will appear as the letter 'b'.
T F 8. Oxygen is an example of an element.
T F 9. The following are all examples of Physical properties: state, color, odour, taste, clarity, lustre, and form.
10. Respiration, digestion, reproduction and growth are life processes carried out by all cells.

SECTION C - MATCHING (8 MARKS)
In the space provided, place the letter of the organelle in column A which best matches it to its appropriate function in column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Vacuole</td>
<td>_____ Gives the plant cell a sturdy support which lets the plant grow upright.</td>
</tr>
<tr>
<td>B. Cytoplasm</td>
<td>_____ Storage area for water, fats, starch, and cell waste.</td>
</tr>
<tr>
<td>C. Cell Wall</td>
<td>_____ Contains the organelles which are membrane bound structures.</td>
</tr>
<tr>
<td>D. Cell Membrane</td>
<td>_____ This is where photosynthesis occurs. It contains chlorophyll.</td>
</tr>
<tr>
<td>E. Nucleus</td>
<td>_____ Site of cellular respiration, known as the power house of the cell.</td>
</tr>
<tr>
<td>F. Chloroplast</td>
<td>_____ Control centre of the cell. Instructions from here guides all the activities in the cell. Plays as important role in: 1) reproduction, 2) heredity.</td>
</tr>
<tr>
<td>G. Mitochondria</td>
<td>_____ They are a transportation system for carrying materials to different parts of the cell.</td>
</tr>
<tr>
<td>H. Endoplasmic Reticulum</td>
<td>_____ Small openings in this organelle allow for the exchange of food and waste in and out of the cell.</td>
</tr>
</tbody>
</table>

SECTION D: SHORT ANSWER QUESTIONS (21 MARKS)
Answer the following questions in the spaces provided.

1. Calculate the mass of sugar which has a volume of 200 cm³, and a density of 50g/cm³. (2) \[ \text{mass} = \text{density} \times \text{volume} \]

2. Determine the volume of a glass of milk which has a mass of 60g and a density of 120g/cm³. (2) \[ \text{volume} = \frac{\text{mass}}{\text{density}} \]

3. Match the following symbols to their appropriate chemical name. (3)

\[
\begin{align*}
\text{H} & \quad \text{Nitrogen} \\
\text{Ca} & \quad \text{Calcium} \\
\text{He} & \quad \text{Oxygen} \\
\text{C} & \quad \text{Hydrogen} \\
\text{O} & \quad \text{Carbon} \\
\text{N} & \quad \text{Helium}
\end{align*}
\]
4. Circle the best unit of measurement for the following situations. (3)
   i) your height  g  cm  m
   ii) The mass of your Christmas turkey  cm³  kg  ml
   iii) The distance from Orillia to Toronto  km  m  kl

5. Using the conversion scale below convert the following metric measurements. (5)

   kilo  hecto  deca  BASE  deci  centi  milli
   (k)  (h)  (da)  UNIT  (d)  (c)  (m)

   i) 315 kg = __________ g
   ii) 56 cm = __________ dm
   iii) 0.5137 kl = __________ ml
   iv) 2.1 dag = __________ cg
   v) 17 dm = __________ km

6. Label the following parts of the compound microscope below. (6)

   [Diagram of a microscope]

7. Label the organelles in the following plant and animal cell. (6)

   [Diagram of a plant and animal cell]

8. Give two reasons why cells divide. (2)
   i) ____________________________________________________________
   ii) ____________________________________________________________

9. People often gargle with salt water to prevent bacteria from giving them a sore throat. Using the sketch below of a cell describe why this is useful. (Use an arrow to represent water flow.) (2)

   [Diagram of a cell with salt water]
Part A  Multiple Choice - 15

1. Objects that produce light are said to be:
   a) fluorescent    b) non-luminous    c) luminous    d) reflective

2. The part that heats up in an incandescent light bulb is made of:
   a) nitrogen      b) silver          c) antimony    d) tungsten

3. Which of the following types of objects will transmit the most light?
   a) opaque      b) transparent    c) translucent    d) conductive

4. A dark shadow produced, where no light reaches it is called a(n):
   a) penumbra    b) umbra          c) dark spot    d) umbrella area

5. A shadow produced by light from a point source:
   a) will only produce an umbra no matter where the object is in reference to the screen
   b) will only produce an umbra if the source is close to the screen
   c) will only produce a penumbra
   d) will produce a penumbra if the object is far away

6. Which of the following is NOT a possible characteristic of an image?
   a) size of the image
   b) colour of the image
   c) attitude of the image
   d) image type (real or virtual)

7. To make the image in a pinhole camera larger:
   a) move closer to the object
   b) move away from the object
   c) make sure you are at a position so the image produced is erect
   d) none of the above

8. A mirror that bulges inward in the middle is said to be:
   a) converging    b) diverging    c) plane    d) spherical

9. What colour of light will be absorbed by a magenta filter?
   a) blue    b) red    c) green    d) cyan

10. When white light passes through a prism the colour of light that is refracted the most is:
    a) red    b) blue    c) green    d) violet
11. What colour will result if cyan and red coloured lights are added together?  
   a) black  b) blue  c) white  d) red

12. The theory that is used to explain the resulting colours when coloured lights are added together is called:  
   a) the division colour theory  
   b) the multi-colour theory  
   c) the subtractive colour theory  
   d) the additive colour theory

13. The principal axis is:  
   a) the straight line passing through the vertex and the centre of curvature  
   b) the distance from the principal focus to the vertex  
   c) the geometric centre of the mirror  
   d) the centre of the sphere from which the shape of the mirror is taken

14. When the object is beyond the focal point of a converging mirror, which of the following does NOT accurately describe the image? The image is:  
   a) erect  b) in front of the mirror  c) real  d) inverted

15. Why are certain medicine bottles and wine bottles made of dark coloured glass?  
   a) they look better on the store shelves  
   b) so children will not be tempted to open the bottles  
   c) so certain colours of light won't pass through the bottle and ruin the product  
   d) none of the above

Part B - Fill in the blanks - 10

1. The subtractive secondary colours are  
   __________________________  __________________________  __________________________

2. If light passes through a cyan filter, the colours that will pass through are:  
   __________________________

3. If the centre of curvature is 20 cm the focal point is ______.

4. The angle of incidence is equal to the ________  __________.

5. An image is located 15 cm from a converging mirror, if the focal point is 7.5 cm. The object is located ______ from the mirror.

6. The branch of study that investigates light phenomena using the light ray model is called: __________________________  __________________________.

7. Light is invisible when it travels through a ____________.
1.) The lettering on some emergency vehicles is backward. Why do you think this is done?

2.) If you were given a converging mirror and asked to experimentally determine its focal length, describe the procedure you would use to complete this task accurately.

3.) How would you use a converging mirror to start a campfire on a sunny day in the summertime?

4.) A girl is standing 4.0 m away from a plane mirror. How far away from the girl will her image appear? What other characteristics will her image have?

5.) With the aid of a diagram, explain how either a solar eclipse or a lunar eclipse occurs. Include in your diagram and explanation a description of partial and total eclipses.
6.) By drawing normals and measuring appropriate distances, locate and draw the image of each figure:
   a.)
   b.)

7.) Complete the following light ray diagrams and describe the characteristics of each image.
   a)
   b)
   c)
8.) Classify each of the following materials as being transparent, translucent, or opaque.

frosted glass

tinted glass

hydrochloric acid

a block of wood

a windshield

9.a) With the aid of a diagram, explain how an incandescent light bulb produces light.

b.) How does a fluorescent lamp produce light? Is this more efficient? Why or why not?

10.) What evidence is there that light travels in straight lines?
11. Using the following list of words, label the diagram below.

incident ray    normal
reflected ray   angle of reflection
angle of incidence mirror surface

12.a) Draw and label a diagram to show how a prism can be used to split light into its spectral colours. Label the colours in the correct colours.

b) How could you get white light from the spectral colours?

13.) Using a diagram, determine the resulting colour when:

a) white light is passed through a magenta filter and then a cyan filter.

b) white light is passed through a yellow filter and then a blue filter.

14.) Fill in the missing colours.

a) blue light + _______ = magenta light

b) green light + _______ = yellow light

c) green light + _______ = white light

d) blue light + yellow light = _______
Science Quiz #

LAB SAFETY

Name ___________ Date ___________

MARK __________/40 = __________/40

1. Who is the biggest danger in the lab? (1)
2. No experiment should be attempted without your _________ and your _________ in the classroom. (4)
3. Is it important for a person who wears regular eyeglasses to wear approved safety goggles? _________ Why? (1 + 2 = 3)
4. State three things you should NEVER do in the lab. (2 x 3 = 6)
   1.
   2.
   3.
5. What is one of the most common injuries suffered in the lab? State one precaution that will prevent such an injury. (1 + 2 = 3)
6. State three precautions a keen grade nine students would follow in order to prevent injuries due to explosions. (6)
7. What are three rules to follow if you are using a bunsen burner in your experiment? (2 x 3 = 6)
8. Explain the proper procedure when mixing a strong acid with water. (2)
PART 1: FILL IN THE BLANKS

Place the most appropriate word in the space provided.

1. A substance that allows all light to pass through is called _________________.
2. ________________ consists of dead epidermal cells which protects the tree from insects.
3. ________________ is the green pigment needed for photosynthesis.
4. Matter that is not charged is said to be _________________.
5. ________________ is the movement of particles from an area of high concentration to an area of low concentration.
6. The nutrient that is the main energy source for humans is _________________.
7. ________________ is anything that has mass and occupies space.
8. The loss of water through the leaves of plants is known as _________________.
9. Nutrients that the human body needs in large amounts are called _________________.
10. ________________ are negatively charged particles that orbit around an atom.

MACRONUTRIENTS BARK MATTER CARBOHYDRATE
NEUTRAL DIFFUSION ELECTRONS CHLOROPHYLL
TRANSPARENT TRANSPARATION
PART 2: MATCHING
Match the statement on the right to the definition on the left by placing the correct letter in the space provided.

<table>
<thead>
<tr>
<th>Part of a solution that does the dissolving</th>
<th>a</th>
<th>vacuole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object produces its own light</td>
<td>b</td>
<td>taproot</td>
</tr>
<tr>
<td>Produces energy for the cell</td>
<td>c</td>
<td>simple leaf</td>
</tr>
<tr>
<td>Storage area for water and waste</td>
<td>d</td>
<td>compound</td>
</tr>
<tr>
<td>Cells become longer</td>
<td>e</td>
<td>mass</td>
</tr>
<tr>
<td>Image is the same size as the object</td>
<td>f</td>
<td>solvent</td>
</tr>
<tr>
<td>Attaches leaf to stem</td>
<td>g</td>
<td>ribosome</td>
</tr>
<tr>
<td>Has a definite volume but takes the shape of the container</td>
<td>h</td>
<td>plane mirror</td>
</tr>
<tr>
<td>Primary root reaches deep into soil</td>
<td>i</td>
<td>fibrous</td>
</tr>
<tr>
<td>An example is a maple leaf</td>
<td>j</td>
<td>solution</td>
</tr>
<tr>
<td>Made up of two or more atoms</td>
<td>k</td>
<td>luminous</td>
</tr>
<tr>
<td>Amount of matter in a substance</td>
<td>l</td>
<td>mitochondria</td>
</tr>
<tr>
<td>Made up of solute and solvent</td>
<td>m</td>
<td>liquid</td>
</tr>
<tr>
<td>Root spread out over a large area</td>
<td>n</td>
<td>petiole</td>
</tr>
<tr>
<td>Produces protein</td>
<td>o</td>
<td>region of elongation</td>
</tr>
</tbody>
</table>
PART 3: MULTIPLE CHOICE

Choose the letter that best suits the statement.

1. If red and green spotlights are shone together on a white screen the resulting color would be:
   a) blue
   b) magenta
   c) yellow
   d) cyan

2. The correct order (from simplest to most complex) is:
   a) cell, organ, organ system, tissue
   b) tissue, organ system, organ, cell
   c) organ system, organ, cell, tissue
   d) cell, tissue, organ, organ system

3. A plant cell is placed in a very concentrated salt solution, as a result:
   a) water will leave the plant cell
   b) water will enter the plant cell
   c) salt will enter the plant cell
   d) water will not move at all

4. The organelle that controls the cell is the:
   a) mitochondria
   b) chloroplasts
   c) nucleus
   d) golgi bodies

5. The gas that causes limewater to turn milky is:
   a) hydrogen
   b) carbon dioxide
   c) helium
   d) oxygen

6. The amount of space an object occupies is its:
   a) volume
   b) weight
   c) density
   d) mass
7. Sucrose or table sugar is an example of:
   a) protein
   b) fat
   c) vitamin
   d) carbohydrate

8. When an object gives off light when it is heated, it is said to be:
   a) phosphorescent
   b) incandescent
   c) fluorescent
   d) burning

9. The force of water against the cell wall of plants, which keeps them upright, is called:
   a) cytolysis
   b) plasmolysis
   c) turgor pressure
   d) hydrolysis

10. Vitamins and minerals are examples of:
    a) micronutrients
    b) cellulose
    c) protein
    d) macronutrients

PART D: DIAGRAMS

Complete the following in the space provided.

1. Label the following diagram of a monocot stem.

   CORTEX  XYLEM  EPIDERMIS  PITH  PHLOEM
2. Complete the following colour ray diagrams by stating what colour(s) will pass through the filter:

(a) RED > ORANGE > GREEN > VIOLET > YELLOW

(b) RED > GREEN > BLUE > GREEN

(c) RED > YELLOW > GREEN > BLUE > CYAN

3. Label the following diagram of the microscope.
4. Complete the following diagram by filling in the appropriate colours.

<table>
<thead>
<tr>
<th>WHITE</th>
<th>YELLOW</th>
<th>GREEN</th>
<th>CYAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE</td>
<td>MAGENTA</td>
<td>RED</td>
<td></td>
</tr>
</tbody>
</table>

5. Label the regions of the following root tip:
PART E: SHORT ANSWER QUESTIONS

Place the answers in the space provided.

1. Define the following terms:
   a) OPAQUE: ________________________________________________________________
   b) TRANSLUCENT: __________________________________________________________
   c) TRANSPARENT: ___________________________________________________________

2. Do the following metric conversions:
   a) 2.15 g = ________________ mg
   b) 0.0123 km = ________________ dam
   c) 41.2 L = ________________ kL

3. Explain the difference between light bouncing off a mirror and light bouncing off a crumpled piece of tin foil.

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

4. Guard cells are open during the day. Explain why.

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
5. Describe one function of each of the following plant organs:

ROOTS: ____________________________________________

LEAVES: __________________________________________

STEMS: ____________________________________________

6. a) State whether the following are physical or chemical changes:

egg breaking: ________________________________________

paper burning: ______________________________________

iron rusting: ________________________________________

cutting grass: ________________________________________

b) What is the difference between a physical and a chemical change?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

7. Give two situations where cells must divide:

a) __________________________________________________

b) __________________________________________________
8. Give the function of the following plant structures:

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>FUNCTION</th>
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<tbody>
<tr>
<td>PHLOEM</td>
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<td>CORTEX</td>
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</tr>
<tr>
<td>XYLEM</td>
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<tr>
<td>EPIDERMIS</td>
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</tr>
<tr>
<td>CUTICLE</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX L

SCIENCE OLYMPICS

April 17th.

Advance Preparation: Each event must have:
- schedules and rules posted,
- an attendance sheet,
- an evaluation sheet,
- appropriate materials

EVENTS:

1.) EGG RELAY

THE PINK ZONE (GYM) TIME LIMIT: 30 MIN

Materials: 3 triple beam balances 2 dozen eggs
3 graduated cylinders 3 buckets filled with water
paper and 3 pencils 3 calculators
3 stopwatches 3 spoons

Workers: 4-6 workers needed for taking attendance, explaining the rules, timing, evaluation, and setup.

Format: The egg relay is run in heats of three teams. Teams are given an egg and a spoon and must complete an obstacle course in the least amount of time. In the process of completing the course, teams must measure the mass and volume of their egg using the triple beam balance and the graduated cylinder and use this data to calculate the density of their egg in proper units. Students are allowed as many trials as time allows with their best trial counting.

Scoring: 50 points are awarded to the team with the best time and 50 points are awarded to the team that measures the most accurate density. The rest of the teams are ranked for accuracy and time and given points accordingly.

Comments: ______________________________________________________________
____________________________________________________________
____________________________________________________________
____________________________________________________________
2.) STRAW TOWERS  THE GREEN ZONE (CAFETERIA)  TIME LIMIT: 15 MIN

**Materials:**  
- 600 straws
- 3 meter sticks
- 2 whiffle golf balls
- 2 pairs of scissors

**Workers:**  
3-4 workers needed for taking attendance, explaining the rules, and evaluation.

**Format:**  
Each team is given 50 straws. The goal is to make the highest tower that will support a whiffle golf ball. The height of the tower is the vertical distance measured from the floor to where the whiffle golf ball sits. Teams may cut the straws using the scissors if they wish.

**Scoring:**  
One team is awarded 100 points for the highest tower with the rest of the teams awarded points based on their ranking.

**Comments:**  

3.) LASER REFLECTION  THE GREEN ZONE  TIME LIMIT: 15 MIN

**Materials:**  
- Neon Laser
- 2 targets
- Masking tape
- 8 plane mirrors with stands

**Workers:**  
3-4 workers for taking attendance, explaining the rules, and evaluation.

**Format:**  
Teams are to arrange 4 plane mirrors so that the laser beam will reflect off each mirror and hit the target. Each team can only turn on the laser once while setting up their mirrors. **THE TEAMS ARE NOT TO HAVE THE LASER ON WHEN THEY ARE MOVING ANY MIRRORS.** Each team is given two trials.

**Scoring:**  
Teams are awarded points based on what part of the target they have hit. Maximum number of points is 100.

**Comments:**  


4.) RIDDLES  THE GREEN ZONE  TIME LIMIT: 15 MIN

Materials: paper and pencils
prepared riddles

Workers: 3-4 workers needed for taking attendance, explaining the rules, and evaluation.

Format: Teams are to find solutions to mathematical riddles. As they complete each riddle, they are given another riddle to a maximum of 5 riddles. Correct solutions must be written down.

Scoring: Teams are awarded points based on the number of riddles they solve with 100 points being the maximum.

Comments:________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

5.) SLINGSHOT  THE YELLOW ZONE (GYM)  TIME LIMIT: 30 MIN

Materials: 10 pieces of rubber tubing (about 30 cm long each)
6 pairs of nylons
track & field measuring tape
masking tape
12 whiffle golf balls

Workers: 4-5 workers needed for taking attendance, explaining the rules, measuring distances, and evaluation.

Format: Using the materials given, teams are to construct a slingshot that will launch a whiffle golf ball. The goal is to get the maximum distance in the air. During launch, teams may have any number of players holding the slingshot. Teams are allowed practice launches if time permits but only three official launches are allowed. The best launch of the three is recorded.

Scoring: The team with the greatest distance in the air is awarded 100 points with the rest of the teams receiving points based on their ranking.

Comments:________________________________________________________________________
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<tr>
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Note: The table appears to be incomplete or has some missing or unclear entries. The text might be related to team configurations or other logistical arrangements.
APPENDIX M

Bob’s Assessment Tools
General Instructions:

1.) Please read all instructions carefully.

2.) Please write multiple choice answers on the answer sheet in CAPITAL LETTERS.

3.) Please write all numerical and written answers on the foolscap provided.

GOOD LUCK !!

Evaluation:

<table>
<thead>
<tr>
<th>Section</th>
<th>Marking</th>
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</tr>
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<tbody>
<tr>
<td>A</td>
<td>Multiple Choice</td>
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</tr>
<tr>
<td>B</td>
<td>Written Answer</td>
<td>12</td>
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<tr>
<td>C</td>
<td>Numerical Answer</td>
<td>35</td>
</tr>
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<tr>
<td>TOTAL</td>
<td>83</td>
<td></td>
</tr>
</tbody>
</table>

MULTIPLE CHOICE ANSWER SHEET

1.) C
2.) E
3.) C
4.) B
5.) C
6.) E
7.) E
8.) C
9.) D
10.) B
b.) vectors have only magnitude and scalars have magnitude and direction  
c.) scalars have only magnitude and vectors have magnitude and direction  
d.) vectors have only direction and scalars have magnitude and direction  
e.) scalars have only magnitude and vectors have only direction

2.) Choose the list that only contains scalars:  
   a.) velocity, distance, time, speed  
   b.) displacement, acceleration, velocity  
   c.) distance, time, acceleration  
   d.) speed, distance, acceleration  
   e.) speed, distance, time

3.) Displacement can be obtained from:  
   a.) the slope of a position time graph  
   b.) the area under a position time graph  
   c.) the area under a velocity time graph  
   d.) the slope of a velocity time graph  
   e.) the area under an acceleration time graph

4.) Which of the following is possible?  
   a.) velocity [S], displacement [N], and acceleration[S]  
   b.) velocity [S], displacement [S], and acceleration[N]  
   c.) velocity [N], displacement [S], and acceleration [S]  
   d.) all of the above  
   e.) none of the above

5.) Which of the following graphs represents an object moving with constant velocity?  

6.) An object accelerates from 5 m/s to 20 m/s in 10 s. The magnitude of its acceleration is:  
   a.) 2.5 m/s²  
   b.) 150 m/s²  
   c.) 10 m/s²  
   d.) 250 m/s²  
   e.) 1.5 m/s²

7.) For the graph below, the motion of the object is best described as:  
   a.) constant velocity due North  
   b.) constant acceleration due North  
   c.) constant velocity due North  
   d.) zero velocity  
   e.) constant acceleration due South
upward with an initial velocity of 18 m/s.

a.) How much time does it take the ball to return to its original height? (3 marks)

\[ \Delta t = \frac{v_1 - v_2}{a} = \frac{-15}{-9.8} \approx 1.53 \text{ s} \]

b.) What is the maximum height reached by the ball? (3 marks)

\[ \Delta x = \frac{-v^2}{2a} = \frac{-15^2}{2(-9.8)} \approx 11.7 \text{ m} \]

3.) A motorcycle starting from rest accelerates at 0.6 m/s² for 7.0 s.

a.) What velocity does it reach? (3 marks)

\[ v_f = v_i + at = 0 + 0.6 \times 7 = 4.2 \text{ m/s} \]

b.) What is the displacement of the car? (3 marks)

\[ \Delta x = \frac{1}{2} at^2 = \frac{1}{2} \times 0.6 \times 7^2 = 14.7 \text{ m} \]

4.) The position-time graph is for a swimmer swimming out to a buoy. Assuming the swimmer makes it to the buoy, it returns.

a.) How far from shore is the buoy? (2 marks) 40 m

b.) Does she rest? If so, when? (2 marks) Yes, between 40-60 s

c.) What is her fastest velocity? (2 marks) 1.5 m/s

d.) How can you tell from the graph that she made it safely back to shore? (2 marks) \( \Delta d = 0 \) at 80 s

Colour:

1.) Use the additive colour theory to explain how a secondary and a primary colour can combine to produce white light. Give an example of one such combination. (6 marks)

2.) How would the focal length of a given lens change if blue and then red light were used? (6 marks)

3.) A director of a stage production must change an actor's costume from blue to green instantly on stage. How could she use filters on the stage lights to produce this effect? (4 marks)

\( \text{Primary: blue} + \text{yellow} = \text{white} \quad \text{Secondary: yellow} = \text{green + red} \quad \text{and} \quad \text{blue} = b + r + g = w \)

or \( \text{red} + \text{cyan} = \text{white} \quad \text{cyan} = g + b \quad \text{blue} = b + r + g = w \)

or \( \text{green} + \text{magenta} = \text{white} \quad \text{magenta} = r + b \quad \text{blue} = b + r + g = w \)

\( \text{a)} \quad \text{blue} > \text{red} \quad \quad \text{f}_\text{blue} < \text{f}_\text{red} \quad \quad \text{the more the bending} \)

(3) white light on blue costume = blue
A ball is thrown upward. The subsequent motion can best be described as:

- a.) constant acceleration upwards until the ball reaches its maximum height, then constant acceleration downwards on the way down
- b.) constant velocity during the entire motion
- c.) constant velocity upwards on the way up, then constant velocity downwards on the way down
- d.) constant acceleration downwards during the entire motion
- e.) constant acceleration upwards during the entire motion

10.) A car travels West with decreasing velocity. Which of the following statements are true?
- a.) the acceleration is zero
- b.) the acceleration is East
- c.) the acceleration is West
- d.) the velocity is East
- e.) the displacement is East
SPH4A PHYSICS

TEST #3 REVIEW

1.) If an object is at rest, can we conclude that there are no forces acting on it?

2.) A passenger sitting in the rear of a bus claims that he was injured when the driver slammed on the brakes, causing a suitcase to come flying toward the passenger from the front of the bus. If you were the judge in this case, how would you rule?

3.) If a 1000 kg car is moving west at 20 m/s, what is the net force acting on it?

4.) A rubber ball is dropped onto the floor. What force causes the ball to bounce back into the air?

5.) A boat sails 20 km [N], then 34 km [E]. Draw a vector diagram, including a vector for the resultant displacement. Calculate the resultant displacement.

6.) A bullet of mass 15 g leaves the barrel of a rifle with a speed of 800 m/s. If the length of the barrel is 75 cm, determine the force that accelerates the bullet, assuming that the acceleration is constant.

7.) If the speed of an object is doubled, what is the effect on the kinetic energy?

8.) Find the work done in each of the following cases:
   i.) lifting a 20 kg bucket 24 m in the air
   ii.) increasing the speed of a 2.0 kg object from 3.0 m/s to 6.0 m/s
   iii.) applying a force of 200 N on an object over a displacement of 4.0 m

9.) For the pendulum below, calculate the speed of the bob at the bottom of the swing.

![Pendulum Diagram]

10.) The roller coaster shown starts from rest at point A. Find its speed at point B and point C.

![Roller Coaster Diagram]

11.) Find the power of a crane that lifts a 20 kg object 5.0 m in 40 s.

12.) A skydiver, complete with parachute, has a mass of 56 kg. A short time after the skydiver jumps from the aircraft, the force of air resistance is 320 N. Draw a free body diagram. What is the acceleration at that instant?
General Instructions:

1.) Please read all questions carefully.

2.) Please answer all multiple choice questions on the answer sheet in CAPITAL LETTERS.

3.) Please use proper units for numerical solutions.

4.) Please use proper terms for written answers.

GOOD LUCK!!

EVALUATION

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<th>TYPE</th>
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MULTIPLE CHOICE ANSWER SHEET

1.) _____  6.) _____
2.) _____  7.) _____
3.) _____  8.) _____
4.) _____  9.) _____
5.) _____  10.) _____
Section A: Multiple Choice (20 marks)

1.) A crossbow archer wants to shoot an arrow of mass 0.02 kg to a vertical height of 50 m. The force constant of the bow is 50 N/m. How far must the string in the bow be pulled back?
   a.) 0.20 m  
   b.) 0.40 m  
   c.) 0.45 m  
   d.) 0.63 m  
   e.) 1.6 m

2.) A ball is dropped from a certain height onto a concrete sidewalk. When it bounces up again it doesn't quite reach the height from which it was dropped because
   a.) momentum is not conserved  
   b.) the ball momentarily stops during impact  
   c.) the force of gravity slows the ball down  
   d.) the law of conservation of energy is only approximately true  
   e.) some of the ball's energy is converted to heat energy

3.) What force will cause a .80 kg puck travelling at 3.4 m/s to come to rest in 0.82 s?
   a.) 3.3 N  
   b.) 0.2 N  
   c.) 3.5 N  
   d.) 0.4 N  
   e.) 1.3 N

4.) Which of the following would describe a perfectly elastic collision between two bodies?
   a.) Momentum is transferred from one body to another, but no kinetic energy is transferred from one body to the other.  
   b.) Total kinetic energy is the same after the collision as before, and total momentum is the same after the collision as before.  
   c.) Total kinetic energy is the same after the collision as before, but total momentum is not the same after the collision as before.  
   d.) Total kinetic energy is not the same after the collision as before, but total momentum is the same after the collision as before.  
   e.) Total momentum is the same after the collision as before, and there is deformation to either body during the collision.

5.) In moving an object 7.0 m, 40 J of energy were used. The average force exerted is closest to
   a.) 280 N  
   b.) 47 N  
   c.) 28 N  
   d.) 5.7 N  
   e.) 0.18 N

6.) A hockey puck of mass 0.80 kg has a kinetic energy of 0.256 J. Its velocity is
   a.) 0.8 m/s  
   b.) 6.4 m/s  
   c.) 0.64 m/s  
   d.) 0.08 m/s  
   e.) 0.064 m/s

7.) If two different masses have the same kinetic energy, their momenta are
   a.) proportional to their masses  
   b.) proportional to the squares of their masses  
   c.) proportional to the square roots of their masses  
   d.) inversely proportional to the squares of their masses  
   e.) inversely proportional to the square roots of their masses

8.) A rifle of mass M is initially at rest but free to recoil. It fires a bullet of mass m with a velocity v relative to the ground. After firing, the velocity of the rifle relative to the ground is
   a.) mv  
   b.) \(-\frac{mv}{M + m}\)  
   c.) \(-\frac{mv}{M}\)  
   d.) \(v\)  
   e.) \(-\frac{mv}{M}\)
9.) A body moves in a circle at constant speed. The work done by the centripetal force on this body is zero because 
a.) the net displacement of the body after each revolution is zero 
b.) the average force on the body over each revolution is zero 
c.) there is no friction on a body moving in a circle at constant speed 
d.) the magnitude of the acceleration of the body is zero 
e.) the centripetal force on the body and the direction of its motion are perpendicular at every instant

10.) What amount of work is required to lift a 14 kg mass a distance of 7.0 m? 
   a.) 9.8 J  
   b.) 21 J  
   c.) 98 W  
   d.) 98 J  
   e.) 980 J

Section B: Written Answer (12 marks)

1.) When a ball rolls down an incline, its momentum increases. Does this imply that momentum is not conserved. Explain. (4 marks)

2.) Briefly explain using "Physics terms" why hitting a brick wall at 20 m/s is more dangerous than hitting a haystack at 20 m/s. (4 marks)

3.) A man sitting in a boat in the middle of Lake Couchiching walks to the opposite end of the boat toward the East. In what direction does the boat move? How do you know? (4 marks)

Section C: Numerical Answer (36 marks)

1.) Calculate the work done by a force of 460 N acting at an angle of 37° to the displacement of 40 m. (3 marks)

2.) A 0.26 kg baseball is thrown by Norm Charlton with a speed of 18 m/s. It is hit straight back at him by John Olerud with a speed of 32 m/s. 
a.) What is the impulse delivered to the ball? (3 marks) 
b.) If the bat is in contact with the ball for 0.018 s, what is the average force exerted on the ball by the bat? (3 marks)

3.) A car of mass 3200 kg travelling at 12 m/s collides with a 4000 kg car initially at rest. If the two cars become attached, find their mutual speed. (3 marks)

4.) A 5.0 g particle moving to the right with a speed of 20 cm/s makes an elastic head-on collision with a 10 g particle initially at rest. 
a.) Find the final velocity of each particle. (3 marks) 
b.) Find the amount of kinetic energy transferred to the 10 g mass. (3 marks)

5.) A 0.009 kg bullet embeds in a 3.0 kg block and causes a spring with k=320 N/m to compress 5.2 cm. Find the initial speed of the bullet. (6 marks)

6.) A 0.012 kg bullet is fired into a 1.4 kg block of wood that is suspended from light strings. If the block rises 1.1 cm, find the speed of the bullet. (6 marks)

7.) For the mass-pulley system shown, use the Principle of Conservation of Energy to determine the velocity when the 4.8 kg mass hits the floor. (6 marks)
SCIENCE DEPARTMENT

SPH4A PHYSICS - UNIT TEST #5

Instructor: Mr.  Name:____________________

General Instructions:

1.) Read all instructions carefully.
2.) Please answer the multiple choice questions on the answer sheet below.
3.) Please answer the written questions on the foolscap.
4.) Please show all work for numerical answers.
5.) Written answers should be concise and include key terms.

GOOD LUCK!!

Multiple Choice Answer Sheet:

1.) ____  7.) ____
2.) ____  8.) ____
3.) ____  9.) ____
4.) ____ 10.) ____
5.) ____ 11.) ____
6.) ____ 12.) ____

Marks:

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<th>Section A</th>
<th>Multiple Choice</th>
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<td>Section B</td>
<td>Extended Answer</td>
<td>156</td>
</tr>
<tr>
<td>TOTAL</td>
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<td>180</td>
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Section A: Multiple Choice (20 marks)

1.) A crossbow archer wants to shoot an arrow of mass 0.02 kg to a vertical height of 50 m. The force constant of the bow is 50 N/m. How far must the string in the bow be pulled back? 
   a) 0.20 m  
   b) 0.40 m  
   c) 0.45 m  
   d) 0.63 m  
   e) 1.6 m

2.) A ball is dropped from a certain height onto a concrete sidewalk. When it bounces up again it doesn’t quite reach the height from which it was dropped because 
   a.) momentum is not conserved  
   b.) the ball momentarily stops during impact  
   c.) the force of gravity slows the ball down  
   d.) the law of conservation of energy is only approximately true  
   e.) some of the ball’s energy is converted to heat energy

3.) What force will cause a .80 kg puck travelling at 3.4 m/s to come to rest in 0.82 s? 
   a.) 3.3 N  
   b.) 0.2 N  
   c.) 3.5 N  
   d.) 0.4 N  
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4.) Which of the following would describe a perfectly elastic collision between two bodies? 
   a.) Momentum is transferred from one body to another, but no kinetic energy is transferred from one body to the other.  
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5.) In moving an object 7.0 m, 40 J of energy were used. The average force exerted is closest to  
   a.) 280 N  
   b.) 47 N  
   c.) 25 N  
   d.) 5.7 N  
   e.) 0.18 N

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   b.) 6.4 m/s  
   c.) 0.64 m/s  
   d.) 0.08 m/s  
   e.) 0.064 m/s

7.) If two different masses have the same kinetic energy, their momenta are  
   a.) proportional to their masses  
   b.) proportional to the squares of their masses  
   c.) proportional to the square roots of their masses  
   d.) inversely proportional to the squares of their masses  
   e.) inversely proportional to the square roots of their masses

8.) A rifle of mass M is initially at rest but free to recoil. It fires a bullet of mass m with a velocity v relative to the ground. After firing, the velocity of the rifle relative to the ground is 
   a.) -\frac{mv}{M+m}  
   b.) -\frac{mv}{M+m}  
   c.) -\frac{mv}{M}  
   d.) -v  
   e.) -\frac{mv}{M}
Section B - Extended Answer

1.) Six 60 Ω resistors are connected in parallel.
   a.) What is the total resistance of the resistors? (3 marks)
   b.) What is the total resistance if the resistors are now connected in series? (3 marks)

2.) Electric power is transmitted over long distances so that the power losses are minimized. Explain how this is done as well as why this works. (8 marks)

3.) Is it possible to have two wires, each made of different material, to have the same resistance? (4 marks)

4.) A 720 W hair dryer is connected to a 120 V source.
   a.) How much current does it require? (3 marks)
   b.) If the resistance in the wires is 1.5 Ω, how much power is lost? (3 marks)

5.) For the following circuit, find I₁, I₂, V₁, V₂ and R₃. (10 marks)

![Circuit Diagram](image1)

6.) For the following circuit, find I₀, I₁, I₂, V₁, and V₂. (10 marks)

![Circuit Diagram](image2)

7.) For the following circuit, find:
   a.) the equivalent resistance, (3 marks)
   b.) the current through the 60 Ω resistor, (3 marks)
   c.) the voltage across the 80 Ω resistor, (3 marks)
   d.) the current through the 240 Ω resistor, (3 marks)

**BONUS:** (3 marks)

For the following circuit, find:
   a.) the equivalent resistance, (1)
   b.) the current through each resistor, (1)
   c.) the voltage between point A and point B, (1)
General Instructions:

1.) Read all instructions carefully.
2.) Please answer the multiple choice questions on the attached answer sheet. The written answers are to be placed on the foolscap.
3.) Please show all work for numerical questions.
4.) All numerical answers should have the correct number of significant digits.
5.) Written answers should be concise and include key terms.

GOOD LUCK!!

Multiple Choice Answer Sheet

1.) ____  6.) ____  11.) ____
2.) ____  7.) ____  12.) ____
3.) ____  8.) ____  13.) ____
4.) ____  9.) ____  14.) ____
5.) ____  10.) ____  15.) ____

Section A: ___________

30

Section B: ___________

45

Total: ___________

75
Section A - Multiple Choice

1.) In an electrical circuit, the current is:
   a.) the speed of the electrons
   b.) the energy per electron
   c.) the number of electrons passing a point per second
   d.) measured using a voltmeter
   e.) b and d

2.) The voltage across a 5 Ω resistor when the current is 5 A is:
   a.) 1 A
   b.) 1 Ω
   c.) 125 Ω
   d.) 25 A
   e.) 25 v

3.) Twelve 2.0 v batteries connected in parallel will produce a total voltage of
   a.) 2.0 v
   b.) 24 v
   c.) 18 v
   d.) 4.0 v
   e.) 12 v

4.) A voltmeter and an ammeter are connected to a circuit. The proper way of connecting these meters is:
   a.) the voltmeter in series and the ammeter in parallel
   b.) the voltmeter in parallel and the ammeter in series
   c.) the voltmeter and ammeter both connected in series
   d.) the voltmeter and ammeter both connected in parallel
   e.) it doesn’t matter how they are connected

5.) The unit of resistance is the:
   a.) ampere
   b.) volt
   c.) coulomb
   d.) watt
   e.) ohm

6.) If the voltage applied to a circuit is doubled and the resistance is halved, the current will be:
   a.) doubled
   b.) halved
   c.) quadrupled
   d.) quartered
   e.) unchanged

7.) A resistance of 2.0 Ω connected across the terminals of a 12 v battery will result in a current of:
   a.) 48 A
   b.) 24 Ω
   c.) 24 A
   d.) 48 v
   e.) 6.0 A

8.) A 12 Ω resistor is connected in parallel with a 6.0 Ω resistor. The total resistance is:
   a.) 18 Ω
   b.) 12 Ω
   c.) 6.0 Ω
   d.) 4.0 Ω
   e.) 0.05 Ω

9.) Four 20 Ω resistors are connected in parallel. If the resulting combination is connected to a 20v battery, the current flowing from the battery is:
   a.) 12 A
   b.) 4.0 A
   c.) 2.4 A
   d.) 2.0 A
   e.) 0.50 A

10.) A household lamp rated at 200 w draws 2.00 A of current. The resistance is:
     a.) 50 Ω
     b.) 100 Ω
     c.) 400 Ω
     d.) 800 Ω
     e.) 10000 Ω

11.) A 12.0 v battery delivers 15.0 A of current. The power supplied is:
     a.) 180 J
     b.) 180 w
     c.) 1.25 w
     d.) 0.800 J
     e.) 0.800 w
Section B - Extended Answer

1.) Six 60 \( \Omega \) resistors are connected in parallel.
   a.) What is the total resistance of the resistors? (3 marks)
   b.) What is the total resistance if the resistors are now connected in series? (3 marks)

2.) Electric power is transmitted over long distances so that the power losses are minimized. Explain how this is done as well as why this works. (8 marks)

3.) Is it possible to have two wires, each made of different material, to have the same resistance? (4 marks)

4.) A 720 W hair dryer is connected to a 120 V source.
   a.) How much current does it require? (3 marks)
   b.) If the resistance in the wires is 1.5 \( \Omega \), how much power is lost? (3 marks)

5.) For the following circuit, find \( I_1, I_2, V_1, V_2 \) and \( R_3 \). (10 marks)

6.) For the following circuit, find \( I_0, I_1, I_2, V_1, \) and \( V_2 \). (10 marks)

7.) For the following circuit, find:
   a.) the equivalent resistance, (3 marks)
   b.) the current through the 60 \( \Omega \) resistor, (3 marks)
   c.) the voltage across the 80 \( \Omega \) resistor, (3 marks)
   d.) the current through the 240 \( \Omega \) resistor, (3 marks)

BONUS: (3 marks)

For the following circuit, find:
   a.) the equivalent resistance, (1)
   b.) the current through each resistor, (1)
   c.) the voltage between point A and point B, (1)
General Instructions:

1.) Please read all instructions carefully.

2.) Please write multiple choice answers on the answer sheet in CAPITAL LETTERS.

3.) Please write all numerical and written answers on the foolscap provided.

GOOD LUCK!!

Evaluation:

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MULTIPLE CHOICE ANSWER SHEET

1.) C
2.) E
3.) C
4.) B
5.) C
6.) E
7.) E
8.) C
9.) D
10.) B
MULTIPLE CHOICE

1. Three kinds of waves are given below:
   (a) electromagnetic waves
   (b) longitudinal waves
   (c) transverse waves

   The sound of church bells is transmitted to your ears by
   (a) I only
   (b) II only
   (c) III only
   (d) I and II only
   (e) I and III only

2. A tuning fork of frequency 384 Hz is sounded at the same time as a guitar string. 30 beats are heard in 10 s. The frequency of the string in hertz is
   (a) 38.4
   (b) 354 or 414
   (c) 369 or 399
   (d) 374 or 394
   (e) 381 or 387

3. Two tuning forks, having frequencies of 310 Hz and 320 Hz respectively, are sounded together loudly. An observer standing at a point several metres away will hear
   (a) continuous silence
   (b) a steady loud sound
   (c) a sound whose frequency is 315 Hz
   (d) a sound with 20 beats per second
   (e) a sound with 10 beats per second

4. Which one of the following cannot transmit sound?
   (a) liquid air
   (b) gaseous oxygen
   (c) liquid water
   (d) solid steel
   (e) perfect vacuum

5. A tuning fork, producing sound waves of wavelength causes resonance in a closed air column. The length of the air column could not be
   (a) \( \lambda \)
   (b) \( \frac{\lambda}{2} \)
   (c) \( \frac{\lambda}{4} \)
   (d) \( \frac{\lambda}{8} \)
   (e) \( \frac{\lambda}{16} \)

6. A tuning fork of frequency 440 Hz resonates with an air column closed at one end. The speed of sound in air is 330 m/s. What is the shortest air column to the closest cm that resonates with this tuning fork?
   (a) 19 cm
   (b) 33 cm
   (c) 35 cm
   (d) 67 cm
   (e) 75 cm

7. A sound wave of wavelength 0.400 m has a speed of 360 m/s. The frequency of the sound is
   (a) 0.400 Hz
   (b) 9.00 Hz
   (c) 14.4 Hz
   (d) 360 Hz
   (e) 900 Hz

8. The shortest resonant length of a certain air column closed at one end is 20 cm. The wavelength of the sound waves is
   (a) 5.0 cm
   (b) 10 cm
   (c) 20 cm
   (d) 40 cm
   (e) 80 cm

9. A stretched string vibrates with a fundamental frequency of 100 Hz. The frequency of the second harmonic is
   (a) 25 Hz
   (b) 50 Hz
   (c) 100 Hz
   (d) 200 Hz
   (e) 400 Hz
10. The first resonant length of a tube, open at both ends, is 40 cm. The wavelength of the sound which will produce this resonance is

(a) 10 cm
(b) 20 cm
(c) 40 cm
(d) 80 cm
(e) 150 cm

11. The Universal Wave Equation is

(a) $v = \lambda$
(b) $v = \frac{f}{\lambda}$
(c) $f = \frac{v}{\lambda}$
(d) $v = \omega$
(e) $v = \frac{1}{2}$

12. If the period is $1.25 \times 10^{-2}$ s, the frequency is

(a) 80.0 Hz
(b) 1.25 x 10^4 Hz
(c) 1.25 x 10^2 Hz
(d) 8.00 Hz
(e) 800 Hz

13. An air column closed at one end filled with argon resonates with a 200 Hz tuning fork. The shortest resonant length is 42.5 cm. The speed of the sound must be

(a) 85.0 m/s
(b) 170 m/s
(c) 340 m/s
(d) 470 m/s
(e) 940 m/s

14. If the temperature of the air increases by 15°C, the speed of sound in the air

(a) decreases by 0.60 m/s
(b) increases by 0.60 m/s
(c) decreases by 9.0 m/s
(d) increases by 9.0 m/s
(e) increases by 24 m/s

15. Organ pipe X, which is open at both ends, is twice as long as organ pipe Y, which is closed at one end. The ratio of the fundamental frequency of pipe X to the fundamental frequency of pipe Y is

(a) 1:1
(b) 1:2
(c) 2:1
(d) 1:4
(e) 4:1
Section B

1.) The echo of a ship's foghorn, reflected from an iceberg, is heard 5.0 s after the horn is sounded. The temperature is -10.0°C. How many meters away is the iceberg? (6 marks)

2.) How do transverse waves differ from longitudinal waves? A diagram may be helpful. (5 marks)

3.) Waves travelling along a 4 m stretched string at 12 m/s produce a "four looped" standing wave. Determine the wavelength, period, and frequency. (6 marks)

4.) A pipe has a length of 1.30 m.
   a.) If the pipe is open at one end, find the fundamental frequency and the frequencies of the first two overtones. Assume the speed of sound is 345 m/s. (6 marks)
   b.) What are the first three frequencies if the pipe is open at both ends? (6 marks)

5.) State what effect that each of the following changes will have on the frequency of a stretched guitar string:
   a.) Increasing the tension in the string by a factor of 4. (2 marks)
   b.) Decreasing the length of the string by a factor of 4. (2 marks)

6.) A violin string is 25.4 cm long and produces a fundamental frequency of 440 Hz. What change in length is required to produce a frequency of 523.3 Hz? (6 marks)

7.) A train approaches a border crossing at 95 km/hr. If the train whistle has a frequency of 288 Hz and the temperature is 15°C, what is the frequency of the sound heard by the guard at the crossing? (6 marks)
General Instructions:

1.) Please answer multiple choice questions on the answer sheet using CAPITAL LETTERS.

2.) Please use and draw diagrams where applicable.

3.) Correct answers include correct units and correct direction where applicable.

GOOD LUCK !!

MARKING SCHEME:

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<th>Section A</th>
<th>Multiple Choice</th>
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<td>Numerical Answer</td>
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MULTIPLE CHOICE ANSWER SHEET:

1.)   
2.)   
3.)   
4.)   
5.)   
6.)   
7.)   

NAME: ____________________
 SECTION B: WRITTEN ANSWER (14 MARKS)

1.) Use Newton's Laws of Motion to explain:
   i.) Why do you have to push harder on the pedals of a bicycle when first starting out than when moving at a constant velocity? (3 marks)
   ii.) One of Newton's laws states that for every force there is an equal reaction force. If this is true, how is it that objects ever accelerate? (3 marks)

2.) When will your apparent weight be greatest, as measured by a bathroom scale in a moving elevator: a.) accelerates upward, b.) accelerates downward, c.) is in free fall, d.) is moving with a constant velocity. Explain your answer. (4 marks)

3.) Describe all of the energy transformations as a rock is dropped from rest from a cliff. (4 marks)

 SECTION C: NUMERICAL ANSWER (27 MARKS)

1.) A 8.0 kg object undergoes an acceleration of 3.0 m/s².
   a.) What is the magnitude of the net force acting on it? (2 marks)
   b.) If the same force is applied to a 4.0 kg object, what acceleration will be produced? (2 marks)

2.) A 5.0 kg mass starts from rest and accelerates constantly over a distance of 1.2 m in 6.0 s. Find the magnitude of the force that causes this acceleration. (4 marks)

3.) A rock is dropped from a height of 28 m. Neglecting air resistance, use the Conservation of Energy to:
   a.) find its speed when it hits the ground. (3 marks)
   b.) find the height at which the rock will have half this speed. (3 marks)

4.) A planet has had its mass reduced by a factor of 10 and its radius increased by a factor of 5. What will be the net effect on the force of gravity on the planet's surface? (4 marks)

5.) How much power is used by a pump that lifts 7.00 kg of water to a height of 3.6 m in 1.0 minute? (3 marks)

6.) A roller coaster is shown below. Assuming no friction, calculate the speed at points B, C, and D, assuming it has a speed of 1.80 m/s at point A. (6 marks)
SECTION A: MULTIPLE CHOICE (20 MARKS)

1.) The work done on a 3.0 kg block in lifting it
2.0 m is:
   a.) 6.0 J
   b.) 1.5 J
   c.) 59 J
   d.) 118 J

2.) A net force of 90.0 N does 45.0 J of work on a brick. What is the magnitude of the
displacement of the brick?
   a.) 0.50 m
   b.) 2.00 m
   c.) 45.0 m
   d.) 135 m
   e.) 4.02 x 10^3

3.) Whenever one body exerts a force on a
   second body the second body exerts a
   force on the first body which is
   a.) slightly smaller in magnitude and in
       the same direction.
   b.) slightly smaller in magnitude and in the
       opposite direction.
   c.) equal in magnitude and in the same
       direction.
   d.) equal in magnitude and in the opposite
direction.
   e.) slightly larger in magnitude and in the
       opposite direction.

4.) The tension, T, in the rope attached to the
   object shown is 5.0 N, and the force of gravity,
   F, acting on the object is 3.0 N. The unbalanced
   force acting on the object is
   a.) -2.0 N [up]
   b.) 2.0 N [down]
   c.) 2.0 N [up]
   d.) 6.0 N [down]
   e.) 8.0 N [up]

5.) An elevator weighing 12000 N is
   accelerating upward. The tension in
   the cable is 20000 N and the frictional
   resistance to motion is 5000 N. The
   unbalanced force on the elevator is
   a.) 37000 N [up]
   b.) 27000 N [up]
   c.) 13000 N [up]
   d.) 8000 N [up]
   e.) 3000 N [up]

6.) An object is given an acceleration of
   2.0 m/s^2 by a net force of 4.0 N. The mass
   of the object is
   a.) 0.50 kg
   b.) 2.0 kg
   c.) 15 kg
   d.) 20 kg
   e.) 50 kg

7.) A body of mass 5.0 kg is moving on a
   smooth surface with a velocity of 6.0 m/s
to the right. A constant force is applied for
3.0 s, giving the body a final velocity of 12 m/s
to the left.
   The applied force was
   a.) 10 N to the left
   b.) 10 N to the right
   c.) 20 N to the left
   d.) 30 N to the left
   e.) 30 N to the right

8.) If a force of 6.0 N acts for a distance of 7.0 m,
how much work is done?
   a.) 42 N
   b.) 42 J
   c.) 12 N
   d.) 12 J
   e.) 56 J
ISU PROPOSAL - EARLY QUANTUM THEORY

The development of Early Quantum Theory has been fast paced and exciting. Many scientists in this century have devoted their careers to theorizing and experimenting so that we may have a deeper understanding of Quantum Theory.

With this in mind, this unit will attempt to expose the significant contributions made by 16 scientists. These contributions are all seen by historians and scientists as pivotal to the advancement of quantum theory. Each of these 16 scientists is either a winner or co-winner of the Nobel Prize for Physics.

The way that this ISU will evolve is as follows:

1.) Groups of three will be formed by lottery.

2.) Each group will select two scientists in a lottery and will research the most important contribution of each scientist to Early Quantum Theory. Students will have some class time to do research. From this research, each group will produce a seminar outlining their findings. This seminar will be at least twenty minutes in length. These seminars will take place in chronological order of each scientist's work.  

3.) If your scientist has equations that he developed, these should be presented along with examples of how to use them.

4.) Possible places to look for research are:
   - textbooks
   - library articles
   - encyclopedias
   - CD ROM encyclopedias
   - internet

5.) One suggestion for evaluation of the seminars is the following:

<table>
<thead>
<tr>
<th>Class</th>
<th>/20</th>
<th>Group</th>
<th>/20</th>
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<tbody>
<tr>
<td>Teacher</td>
<td>/20</td>
<td>Self</td>
<td>/20</td>
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<tr>
<td>Group mark</td>
<td>/40</td>
<td>Individual mark</td>
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Each student will thus be marked out of 80.

8.) The list of scientists:
   - Planck
   - Einstein*
   - Heisenberg
   - Schrodinger
   - Millikan
   - Franck and Hertz
   - Bragg (father & son)
   - deBrogie
   - Dirac
   - Enrico Fermi
   - Davisson and Germer
   - Bohr
   - Compton
   - Pauli
SECONDARY SCHOOL

PHYSICS

INDEPENDENT STUDY WORK

Introduction:

Your independent study work in this course will consist of two components. The first of these components is a short essay. This will make up 60% of your independent study mark. The other component will consist of your involvement in the Annual Science Olympics. This component will be worth 40% of your independent study mark.

Essay: (60 G)

This type of report is designed for you to explore an area of interest within the topics that we cover in this course. It is therefore very important that you choose a topic that is of particular interest to you.

The essay will involve a thorough literature search on your topic. Relevant literature is to be read and analyzed by the student, and a well-organized paper written that reflects the fact that the student has understood and synthesized the information collected on the topic. Standard format for a scientific literature review article, involving both footnotes and works cited list, must be followed. The paper should emphasize the physics involved and the societal impact of the physics.

A good starting point for your literature search is the CD ROM in the computer room of the Magazines Express in the library. These are excellent sources and it is expected that ALL of you will take advantage. Other sources include the public library and libraries at local universities. An essay must have at least 4 different sources cited.

All literature that is cited must have publication dates of 1985 or later. For maximum authenticity you are encouraged to use resources that were published after 1990. With this in mind, it is hoped that you pick a topic that is "sexy".

YOUR TEXTBOOK IS NOT TO BE USED OR CITED IN YOUR ESSAY.

ESSAY LENGTH - 6 PAGES MINIMUM (STOP READING AFTER 8 PAGES.)

ESSAYS must be DOUBLE SPACED and TYPED.

TWO copies of your essay are to be submitted.

Evaluation of essay: Deadlines

Footnotes 8 pts
Sources 15 pts
Style 8 pts
Contact 20 pts
TOTAL 60 PTS

Deadline:

Introduction Selection Sept. 22nd
Outline and Sources Oct. 13th
Final Submission Oct. 30th

* earlier drafts may be submitted for prereading

Topic List

OPTICS
- the use of optical instruments
- the influence of optical instruments on society

ELECTRICITY
- electrical safety at home and at school
- effects of high tension electrical wires

ELECTROMAGNETISM
- operation and application of a device that is based on electromagnetism

SOUND
- noise pollution
- inverse wave sound cancellation
- the physics of the guitar
- electronic music

FLUIDS
- Archimedes', Pascal's, or Bernoulli's principle
- medical applications
- Industrial applications (hydraulics)

Science Olympics (40 G)
# Observation Chart for Science Lab Clean-up

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<td>3. Safety procedures followed</td>
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<td>4. Gas and water turned off</td>
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Name: ________________________________

Date: ____________________________
APPENDIX N
SECONDARY SCHOOL
GUIDELINES AND EVALUATION
SCH3A

Classroom:
It is expected that you will attend class on a daily basis. This includes
being punctual and possessing the proper instruments: pen, paper,
text, calculator.

Participation:
This is an integral part of this chemistry course. You cannot only watch or
observe classroom activities. Active participation is a discipline that must
be performed consistently. With this in mind, the class will be provided
with time, on occasion, to voice concerns (i.e. difficult concepts, pace,
format, labs, etc.).

Homework:
Most of the time, homework will be assigned nightly and will usually take
the form of problem sets or reading. In addition to "assigned" homework,
students should be revising their notes and using the text as a source to
gain a clearer understanding of topics covered in class. "Taking up
homework" the next day will be the responsibility of the students.

Extra Help:
The instructor will be available for extra help sessions predominately
before school and during lunch. If these times are not feasible, please
speak to the instructor to arrange an appointment.

Independent Study:
Please refer to handout.

Assignments:
These will be given on a fairly regular basis. Assignments are to be
handed in at the beginning of class on the date they are due. Late
assignments (maximum one day) will be given half marks. Any
assignments later than one day will be given a mark of zero. In the case
of excused absences, the assignments will be due on the day you return to
school. These provisions will ensure that the assignments will be handed
back at the soonest available date.
Labs:
This is an essential part of the course. Labs are mandatory and must be completed. If you miss a lab, you must arrange a time with the instructor when you can make up the lab. See assignments regarding due dates. **UNSAFE LAB BEHAVIOUR WILL RESULT IN A MARK OF ZERO FOR THAT LAB.**

Quizzes:
Quizzes will be given randomly and some will be of the form of "pop quizzes". These quizzes will be given to encourage the completion of homework assignments.

Tests:
Tests will be given at the end of each unit. These tests will reflect the homework, assignments, quizzes and labs of that particular unit. Test dates will be given approximately one week in advance. If you miss a test, a mark of zero will be recorded unless you supply the instructor with a doctor's note (a make-up test will then be arranged). All tests are weighted equally. **NO TEST MARKS WILL BE DROPPED!**

Exam:
The final exam will cover all units of the course and will be based on homework, assignments, quizzes, labs and tests.

**EVALUATION**

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<td>Quizzes</td>
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<td>Tests</td>
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SCIENCE DEPARTMENT

GUIDELINES AND EVALUATION

SPHIA PHYSICS

Instructor: Mr.

Classroom: It is expected that you attend class daily. This includes being punctual and possessing the proper instruments: pen, paper, text, and calculator.

Participation: This is an integral part of Physics. You cannot only watch or observe. It is a discipline which must be performed on a daily basis. Therefore, we cannot have any passengers. Everyone must guide the ship.

With this in mind, the class will be provided with time, on occasion, to voice any concerns (i.e. - difficult concepts, pace, format, labs, etc.). This is a valuable opportunity to control your own course. This has proven in the past to be beneficial to both students and instructor and can be helpful in producing a great course. The class can bring up any concerns in an organized fashion at any time.

Homework Quizzes: Most of the time, homework will be assigned nightly and will usually take the form of problem sets or reading. In addition, students should be revising notes and using the text as a guide to topics covered in this course. "Taking up homework" the next day can be done at the request of the group. It is thus the responsibility of the students to correct homework in class.

To aid the instructor in monitoring participation in homework, quizzes will be given on a weekly basis. These quizzes are meant to benefit those students who are completing their homework. In addition, these quizzes have proved valuable in rectifying problems that students have.

Office Hours: The instructor will be available for extra help, concerns, etc. at prearranged times. Students can book time with the instructor predominately before school, during period #1 (week 1), or at lunch. Other times may be available with the agreement of student and instructor.

Assignments: These will be given on a regular basis depending on the unit. Assignments are to be handed in at the beginning of class on the date they are due. Late assignments (MAXIMUM ONE DAY) will be worth half marks. Any assignments not handed in at that time will not be graded and the student will receive a mark of zero for that assignment.

Independent Study: SEE HANDOUT

Labs: This is an essential part of any science course. Labs are mandatory and must be completed. If you miss a lab, you must arrange a time with the instructor when you can make up the lab. All lab reports are to be submitted in standard form. See "assignments" above for due dates, etc.

UNSAFE LAB BEHAVIOUR WILL RESULT IN A MARK OF ZERO FOR THAT LAB.

Tests: Tests will be given at the end of each unit. These tests will reflect the homework, assignments, and labs of that unit. Test dates will be given at least one week in advance. This is to allow time to work out any possible conflicts. If you miss a test, a mark of zero will be recorded for that test unless you supply the instructor with a doctor's note (a make-up test date can then be arranged). All tests are weighted equally. NO TEST MARKS WILL BE "DROPPED".

Final Exam: The final exam will cover all units of the course and will be based on assignments, labs, homework, notes, and assignments.

EVALUATION: Quizzes 5%
Assignments 5%
Ind. Study 10%
Lab Reports 20%
Tests 30%

Total 100%
Secondary School Science Department
Guidelines and Evaluation

Self-Evaluation:

During this course, you will be asked to evaluate yourself. This will involve a daily check of your progress in various areas. These areas include: behaviour at the beginning/end of class, work habits, communication skills, and social skills.

This self-evaluation will be constantly monitored by your instructor for its accuracy. If a student's self-evaluation is found to be inaccurate, the instructor reserves the right to make the appropriate corrections.

The final, corrected version will form the basis for parts of your report card.
(SEE HANDOUT)

Tests:

At the end of each science unit, there will be a major test that will encompass the work done in that unit. Tests are not to be missed. A mark of zero will be recorded for a missed test unless the student submits a doctor's note.

These tests will make up 20% of your mark.

Assignments, Quizzes, and Labs:

Periodically during this course you will be expected to perform labs in class (SEE HANDOUT), pass in assignments, and do quizzes. Late lab reports and late assignments will be worth 50% if they are one day late and 0% if they are more than one day late.

These components of the course are worth the percentages listed below.

Notebook:

It is important for you to keep a neat, complete, and thorough set of notes. Guidelines for your notebook are listed in the handout. Your notebook will be graded according to this handout and will be worth 10% of your mark.

Exams:

At the conclusion of this course there will be a final exam on the key concepts presented in this course. This exam will be worth 25% of this course.

Science Olympics:

On November _, you will be participating in the 2nd Annual Patrick Foparty Science Olympics. On this day, you will work with a team of your peers on science related events. Your mark will be based on how your team finishes in these events. This mark will be worth 5% of your mark in this course.

Independent Study Project:

This is an optional component of the course that provides you with the opportunity to study an area of science that you are interested in. (SEE HANDOUT). You will be strongly encouraged to take advantage of this opportunity. This project is worth an extra 5% of your mark.

Evaluation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Tests</td>
<td>20%</td>
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<tr>
<td>Assignments</td>
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<tr>
<td>Labs</td>
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<tr>
<td>Quizzes</td>
<td>10%</td>
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<tr>
<td>Notebooks</td>
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<tr>
<td>Exam</td>
<td>25%</td>
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<tr>
<td>Science Olympics</td>
<td>5%</td>
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<tr>
<td>TOTAL</td>
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BONUS:

INDEPENDENT STUDY PROJECT ... 5%
APPENDIX O

Jan's
Assessment Tools
Total Marks 90

1.) Using examples, distinguish between the following terms: (8)
   a.) heterogeneous mixture / homogeneous mixture
   
   b.) chemical symbol / chemical formula
   
   c.) atom / molecule
   
   d.) solute / solvent

2.) List four factors that are evidence of a chemical reaction: (4)
   a.)
   b.)
   c.)
   d.)

3.) Give the symbols for the following elements: (3)
   
   a.) Tin ________
   b.) Iron ________
   c.) Mercury ________
   d.) Nitrogen ________
   e.) Phosphorus ________
   f.) Oxygen ________

4.) Name the following elements: (3)
   
   a.) Cl ________
   b.) Pb ________
   c.) Al ________
   d.) Ag ________
   e.) Ne ________
   f.) Ca ________

5.) a.) Define physical change and chemical change. (4)
   b.) Give an example of a physical change that can be found at home. (1)
   c.) Give an example of a chemical change that occurs in the lab. (1)
6. (a) Define Ionic Bonding.

6. (b) Explain, with the aid of a diagram, how sodium chloride is formed. (4 diagram, 4 written explanation)

7.) Complete the following chart showing how matter is classified:

[Diagram of a tree chart showing the classification of matter]

8.) Write word equations and name the reactants and the products that would represent the following reactions:

a.) Potassium chlorate is heated to produce potassium chloride and oxygen gas.

b.) A solution of sodium bromide combines with silver nitrate to yield a silver bromide precipitate and sodium nitrate.

c.) Solid carbon reacts with water vapour to form carbon monoxide gas and hydrogen gas.

9.) Give the chemical composition of the following:

a.) $C_{67}H_{114}O_{17}N_{16}S_{1}Fe$, (Hemoglobin: a protein in blood)

b.) $Al_3(CO_3)_1$

c.) $CaCl_2$

d.) $Fe_2O_3$
10. a.) Give the chemical test for each of the following: (3)
   i.) Carbon dioxide gas
   ii.) Hydrogen gas
   iii.) Oxygen gas

b.) Why must these tests be performed? (2)

11.) State whether the following is true or false. GIVE AN EXPLANATION AS TO WHY THE STATEMENTS ARE EITHER TRUE OR FALSE. (10)

a.) The composition of a mixture can change.

b.) All pure substances undergo a change of state over a range of temperatures.

c.) A compound may be separated using only one of the physical separation techniques.

d.) A solution may be separated using either filtration or distillation.

e.) A mechanical mixture may consist of one or more phases.

12. a) State two important conclusions that resulted from Rutherford's Gold Foil experiment (2)

b. Write the Rutherford-Bohr model for Ni. (2)

13.) Complete the following chart: (6)

<table>
<thead>
<tr>
<th>Particle</th>
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<th>Charge</th>
<th>Location</th>
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</table>
1. Define the following terms:
   a) Stoichiometry
   b) Excess reagent
   c) Actual Yield

2. Magnesium reacts with oxygen to produce magnesium oxide.
   a) Write a balanced equation to represent this reaction.
   b) How many moles of oxygen are required to react with 9.7g of magnesium?
   c) How many grams of oxygen are required for the above reaction?

3. Potassium chlorate, when heated, decomposes to produce potassium chloride and oxygen gas.
   How many grams of potassium chlorate must be decomposed to produce 3.40 g of oxygen?
4. How many grams of carbon dioxide will be produced when 8.50g of methane reacts with 15.9g of oxygen gas, according to the following reaction:

\[ CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g) \]

5. a) If 253.50g of iron(II) sulfide was actually obtained in a reaction, calculate the percentage yield if the theoretical yield was 302.61g.

b) Calculate the percentage error of this experiment.

6. Iron (III)sulfide reacts with oxygen gas to produce iron(III)oxide and sulfur dioxide gas.

In an experiment, 8.71 g of iron(III) oxide was produced when 20.9 g of iron(III)sulfide and 9.70g of oxygen gas reacted.

a) Write a balanced chemical equation for this reaction.

b) Determine the limiting reagent in this reaction.

c) Calculate the percentage yield from this reaction.
General Instructions:

1.) Please write multiple choice answers on the answer sheet in CAPITAL LETTERS.

2.) Please write clearly using explicit language.

3.) Check over your answers carefully before handing your paper in.

GOOD LUCK!!

EVALUATION

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<th>Section</th>
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<tr>
<td>Section A</td>
<td>Multiple Choice</td>
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<tr>
<td>Section B</td>
<td>Essay</td>
<td>43 marks</td>
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<tr>
<td>Section C</td>
<td>Graph</td>
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<td><strong>TOTAL</strong></td>
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Multiple Choice Answer Sheet

1.)  ___  7.)  ___  13.)  ___
2.)  ___  8.)  ___  14.)  ___
3.)  ___  9.)  ___  15.)  ___
4.)  ___ 10.)  ___  16.)  ___
5.)  ___ 11.)  ___  17.)  ___
6.)  ___ 12.)  ___  18.)  ___
MULTIPLE Choice QUESTIONS

1. Environment refers to:
   (a) the interaction of living things with each other and with their surroundings
   (b) everything in an organism’s surroundings that is living
   (c) those parts of our surroundings that would be considered abiotic
   (d) everything in an organism’s surroundings

2. Ecology is the science that studies:
   (a) the interaction of living things with each other and with their surroundings
   (b) everything in an organism’s surroundings that is living
   (c) those parts of our surroundings that would be considered abiotic
   (d) everything in an organism’s surroundings

3. The biotic environment refers to:
   (a) the interaction of living things with each other and with their living and non-living surroundings
   (b) everything in an organism’s surroundings that is living
   (c) those parts of our surroundings that would be considered at the top level of a pyramid of biomass
   (d) everything in a organism’s surroundings

4. Decomposers are important because
   (a) they recycle nutrients
   (b) they get rid of bodies
   (c) they produce food
   (d) they create energy

5. Autotrophs:
   (a) supply energy to heterotrophs
   (b) use the sun’s energy directly
   (c) synthesize their own food
   (d) store more energy than they need for their own processes
   (e) all of the above

6. Heterotrophs:
   (a) can use the sun’s energy directly
   (b) rely on autotrophs directly or indirectly for energy
   (c) can store energy in their tissues
   (d) both <a> and <c> above
   (e) both <b> and <c> above

7. The niche of bacteria in an ecosystem is mostly
   (a) producer
   (b) predator
   (c) carnivore
   (d) decomposer
   (e) scavenger

8. An organism that does not kill for itself, but lives off the flesh that has been abandoned by others is called:
   (a) a herbivore
   (b) a saprophyte
   (c) a scavenger
   (d) a parasite

9. An ecosystem is different from an environment in that:
   (a) the organisms in an ecosystem form a distinct group interacting with each other and with their environment
   (b) the ecosystem includes the abiotic environmental factors only
   (c) ecosystems can cover entire continents
   (d) the ecosystem includes the biotic environmental factors only

10. Which of the following factors is not abiotic?
    (a) soil conditions
    (b) amount of light
    (c) number of offspring
    (d) temperature

11. Organisms that are strictly secondary consumers
    (a) are not dependent on herbivores
    (b) are autotrophic
    (c) may be a food source for tertiary consumers
    (d) are the last link in a food chain
    (e) will never be involved in food webs
12. Every food chain must start with a producer because:

(a) herbivores would multiply too quickly
(b) that is the only way that energy can get into the ecosystem
(c) that is the best way to turn biotic energy into abiotic energy
(d) top order carnivores must be in that dominant position

13. A biomass pyramid that has a very large base:

(a) shows there are more tertiary consumers than producers
(b) is not very realistic
(c) shows that many producers are required to support only a few top order consumers
(d) shows that there are more tertiary consumers than primary consumers
(e) none of these is true

14. Trophic levels are:

(a) food levels found in a biomass pyramid
(b) found only in the marine biome
(c) a vital part of the troposphere
(d) mostly made up of plankton
(e) only found in cases of mutualism

15. Which of the following food pyramids will help us to trace the flow of energy through the ecosystem most easily?

(a) a pyramid of numbers
(b) a pyramid showing the mass of each trophic level
(c) a pyramid showing the number of KJ for each trophic level
(d) a pyramid of biomass

16. It is interesting to note, that in an ecosystem, the largest organisms:

(a) are earthworms
(b) are fewest in number
(c) are the fastest ones
(d) are more intelligent

17. Most cycles in nature have to occur because

(a) there is a limited amount of material on our planet
(b) matter must obey the law of conservation of mass
(c) biotic material must return to abiotic material so new life can be produced
(d) all of the above are true
(e) none of the above are true

18. The most important nutrients are:

(a) carbon, water and nitrogen
(b) carbon, potassium and potash
(c) water, sodium and carbon
(d) calcium, ammonia and nitrogen
ESSAY QUESTIONS (43 marks)

1.) Name three biomes and describe each. (9 marks)

2.)
   a.) List three types of symbiosis and describe each. (6 marks)
   b.) The human digestive tract contains bacteria that reproduce important vitamins. What symbiotic relationship does this demonstrate? Explain. (4 marks)

3.) Wolves are carnivores. Explain how placing a bounty on wolves may cause a significant loss in vegetation. (4 marks)

4.) Construct a food chain using the following organisms. Label all trophic levels and organisms. snake, hawk, leaves, worm, bird. (6 marks)

5.) List the main stages of natural succession. What is the final product of succession? (6 marks)

6.) All living things in the environment compete directly or indirectly. Discuss. (6 marks)

GRAPHING (18 marks)

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<td>1915</td>
<td>12</td>
<td>1918</td>
<td>24</td>
</tr>
<tr>
<td>1920</td>
<td>8</td>
<td>1923</td>
<td>2</td>
</tr>
</tbody>
</table>

a.) Plot the population data for the hare and the lynx on the same graph. Connect the points. (8 marks)

b.) Why do changes in the lynx population follow the changes in the hare population? (2 marks)

c.) How can both predator and prey be said to control each other's population? (4 marks)

d.) If there were no lynx controlling the hare population, what would eventually happen to the population of hares? (4 marks)
1. List and describe five of the physical properties discussed in class.
   a)
   b)
   c)
   d)
   e)

2. Describe the following substances using any three physical properties:
   a) sour milk
   b) sand paper
   c) brick

3. State whether the following statements are true or false. If the statement is false, correct the statement in the space provided.
   T or F  a) A physical property can only be determined by conducting an experiment.
   T or F  b) Matter is anything that has mass and occupies space.
   T or F  c) Mass is the amount of space an object occupies.
   T or F  d) Viscosity is a term that applies only to solids and gases.
   T or F  e) Lustre is the ability of an object to transmit light.

4. Complete the following metric conversions:
   a) 56.7 mg = __________ g
   b) 81.32 km = ______________m
   c) .123 cL = __________ hl
   d) 512.48 dm = __________ m
   e) 19.69 dag = ________ cg
   f) 142.3 cm³ = __________ mm³
   g) 5.317 mL = ________ L
   h) 12.64 mg = __________ kg
Answer all questions in the space provided.

1. Match the measurements on the left with the appropriate units on the right. (3)
   
   _____ 1. mass                    i) hL
   _____ 2. volume                  ii) kg/m³
   _____ 3. density                 iii) mg

2. Circle the best units to use when measuring: (3)
   
   a) The amount of water in a pool                     kL  L  m³
   b) The length of a football field                   g  km  m
   c) The weight of a chicken                         cm  mg  g

3. Do the following metric conversions (please use the chart below to help you) (5)
   
   a) 2.58 kg = __________ g
   b) 3.96 ml = __________ dL
   c) 82 kg = __________ g
   d) 4.5 L = __________ cL
   e) 3.004 cm = __________ dam

        kilo   hecto   deca   base   deci   centi   milli
        (da)        unit        (d)
        g             L         m

4. Explain the difference between: (2)
   a) physical property (ie color) and chemical property (ie flammable)

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

   b) qualitative observation (ie the man had brown hair) and quantitative observation (ie the man was six feet tall) (2)

   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
5. What is matter?(2)

6. State one physical property for each of the following:(4)
   Substance/Object  Property
   Brick
   Sand
   Sour Milk
   Perfume

7. Solve the following problems:(4)
   (All work must be shown in the space provided)
   a) What is the volume in \( \text{m}^3 \) of a substance if : (2)
      \[ m = 1500 \text{ kg} \quad v = \frac{m}{d} \]
      \[ d = 250 \text{ kg/m}^3 \]  \[ d \]
      \[ v = ? \]
   b) What is the mass in \( \text{g} \) of a substance if: (2)
      \[ d = 6 \text{ g/cm}^3 \]
      \[ m = v \times d \]
      \[ v = 8 \text{ cm}^3 \]
      \[ m = ? \]

8. Using what you learned about the particle theory, indicate whether the following statements are True or False(5)
   i) T  F  A liquid has a definite shape
   ii) T  F  You can compress a gas.
   iii) T  F  Gas particles have motion.
   iv) T  F  Cold particles move faster than warm particles
   v) T  F  You must remove heat to freeze something.
9. Using the warming curve provided below, answer the following (5)

**WARMING CURVE OF WATER**

![Warming Curve of Water Diagram]

**a) What are the three forms in which you will find water? (3)**
- i) ______________
- ii) ______________
- iii) ______________

**b) What causes water to change state? (2)**

__________________________________________

__________________________________________
SECONDARY SCHOOL
SCIENCE DEPARTMENT

NAME ______________________

Instructions to the student:

1) Fill in your sheet individually during the last few minutes of class and return it completed at the end of the period.

2) Record a number (0 or 1) in each box to evaluate yourself. You must show these behaviors throughout the entire week or a zero will be recorded.

3) Your teacher will check your entries and correct any that are inaccurate. Your teacher may want you to come in at lunch or after school to discuss points of disagreement.

4) Marks will be accumulated and form the basis for sections of your report card.

5) Lost sheets are your responsibility. THESE SHEETS DO NOT LEAVE THE ROOM.

(A) BEGINNING/END OF CLASS

<table>
<thead>
<tr>
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<th>TOTAL</th>
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<tbody>
<tr>
<td>on time for class with materials ready (pens, notes, etc.)</td>
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<tr>
<td>working quietly until end of class or until teacher signals otherwise</td>
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<tr>
<td>leaving a clean lab bench or desk</td>
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(B) COMMUNICATION SKILLS

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<td>expressing opinions and ideas clearly</td>
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<td>raising hands to respond to questions</td>
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<td>asking for assistance in a respectful way</td>
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<td>positive contributions to discussions</td>
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(C) WORKING HABITS

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<tr>
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<tr>
<td>homework done thoroughly</td>
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<tr>
<td>showing eagerness to learn</td>
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<tr>
<td>written work is neat, complete and well organized</td>
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(D) SOCIAL SKILLS

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<th>TOTAL</th>
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</thead>
<tbody>
<tr>
<td>showing respect towards others (no &quot;bull downs&quot;)</td>
<td></td>
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<tr>
<td>cooperative and behaving appropriately</td>
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<tr>
<td>showing leadership in group activities</td>
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<tr>
<td>not interfering with the learning of peers</td>
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Laboratory Participation Checklist - Peer/Self/Teacher

Student Evaluated: ____________________  Course: ____________

<table>
<thead>
<tr>
<th>Task</th>
<th>Criteria</th>
<th>Beginner</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparatus</td>
<td>Obtains appropriate materials for the experiment or activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set-Up</td>
<td>Helps to assemble the equipment as outlined in the activity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean-Up</td>
<td>Helps to dismantle, clean and return apparatus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td>Uses scientific lab procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Safety</td>
<td>Follows all safety rules</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

STUDENT EVALUATOR: ________________________________________________

TEACHER: _________________________  DATE: ______________________
**SCAG - SELF & PEER EVALUATION**

**NAME:**

Instructions: For each of the following sections evaluate the student using the criteria below:

<table>
<thead>
<tr>
<th>Never</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Mostly</th>
<th>Always</th>
</tr>
</thead>
</table>

1. Student was cooperative

2. Student used the equipment properly and followed safety procedures

3. Student stayed on task

4. Student shared equal responsibility in conducting the lab

5. Student maintained a clean work environment and cleaned up afterwards
Name__________________________

Observation Chart for Science Lab Clean-up

<table>
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<th>Date</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>1. All apparatus cleaned up</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2. All apparatus put away</td>
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<td>3. Safety procedures followed</td>
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<tr>
<td>4. Gas and water turned off</td>
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<tr>
<td>5. Countertop cleaned &amp; dry</td>
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(✓) if completed
APPENDIX P

Pat's Assessment Tools
Answer all questions in the space provided.

1. Match the measurements on the left with the appropriate units on the right. (3)
   
   ___ 1. mass  i) hL  
   ___ 2. volume ii) kg/m³  
   ___ 3. density iii) mg

2. Circle the best units to use when measuring: (3)
   
   a) The amount of water in a pool  kL  L  m³  
   b) The length of a football field  g  km  m  
   c) The weight of a chicken  cm  mg  g

3. Do the following metric conversions (please use the chart below to help you) (5)
   
   a)  2.58 hg = ___________ g  
   b)  3.96 ml = ___________ dL  
   c)  82 kg = ___________ g  
   d)  4.5 L = ___________ cL  
   e)  3.004 cm = ___________ dam

   kilo  hecto  deca  base  deci  centi  milli
   (da)  unit (d)  
   g  L  m

4. Explain the difference between: (2)
   a) physical property (ie color) and chemical property (ie flammable)
   
   
   
   
   b) qualitative observation (ie the man had brown hair) and quantitative observation (ie the man was six feet tall) (2)
5. What is matter? (2)

6. State one physical property for each of the following: (4)

<table>
<thead>
<tr>
<th>Substance/Object</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
</tr>
<tr>
<td>Sour Milk</td>
<td></td>
</tr>
<tr>
<td>Perfume</td>
<td></td>
</tr>
</tbody>
</table>

7. Solve the following problems: (4)
(All work must be shown in the space provided)

a) What is the volume in (m³) of a substance if: (2)

\[ m = 1500 \text{ kg} \quad v = \frac{m}{d} \]
\[ d = 250 \text{ kg/m}^3 \]

\[ v = ? \]

b) What is the mass in (g) of a substance if: (2)

\[ d = 6 \text{ g/cm}^3 \]
\[ v = 8\text{ cm}^3 \]

\[ m = ? \]

8. Using what you learned about the particle theory, indicate whether the following statements are True or False (5):

i) T F A liquid has a definite shape

ii) T F You can compress a gas.

iii) T F Gas particles have motion.

iv) T F Cold particles move faster than warm particles

v) T F You must remove heat to freeze something.
Using the warming curve provided below, answer the following (5)

**WARMING CURVE OF WATER**

![Graph showing warming curve with stages: Solid, Liquid, Gas](image)

a) What are the three forms in which you will find water? (3)
   i) ______________
   ii) ____________________
   iii) ____________________

b) What causes water to change state? (2)

__________________________
__________________________
Unit 2 Test

TOTAL / 59

SECTION A: Definitions (10 total)
Define any 5 of the following (2 marks each)

Thermal Energy; Conduction; Thermal Expansion; Kinetic Energy; Convection; Latent Heat of Vaporization; Heat Capacity; Specific Heat Capacity

Section B: Short Answers (18 total)

1. Give one practical example of CONVECTION and explain it fully. (3)
2. Explain the main difference between Radiation & Conduction as methods of heat transfer (2)
3. Explain what happens to electrical lines in both the summer & winter. Make sure you state the scientific principle behind this phenomenon (3)
4. Define Temperature & explain the modern method of measuring temperature changes (be sure to be very detailed!) (4)
5. Label i) where there is a change of state occurring & how you know this (3)
   ii) where there is an increase in temperature occurring (1)

6. Distinguish between Kinetic Energy & Thermal Energy (2)
SECTION C: Mathematics (23 marks total)

Complete on a separate sheet of paper & attach to your test paper WITH YOUR NAME CLEARLY INDICATED!

1. a) Give the equation for LATENT HEAT OF FUSION (1)
   b) How much heat is required to melt 2.5Kg of rock if the rock's latent heat of fusion is $4.8 \times 10^6$ (2) [3 marks]

2. Calculate the amount of heat needed to warm 1.5Kg of cherry slushie from 1° C to 15° C. (Given: $c_{\text{cherry slushie}} = 2300\text{J/Kg}^\circ\text{C}$) [4 marks]

3. A dishwasher contains 42Kg of water at 65°C. The temperature of the cold water from a nearby tap, attached by a hose to the dishwasher, is 15°C. What mass of cold water must be added to adjust the temperature of the hot water to 35°C? (Given: $c_{\text{water}} = 4200\text{ J/Kg}^\circ\text{C}$) [8 marks]

4. When agent Scully finds 1.6 Kg of an unknown liquid at a temperature of 21°C, she added it to 3.0 Kg of water at a temperature of 42°C. Agent Mulder, assisting by holding the thermometer in the unknown mixture + water solution, concluded that the final temperature of the solution was 33°C. What the FBI wants to know is what is the specific heat capacity of the unknown liquid? Is the truth in there? (Given $c_{\text{water}} = 4200\text{ J/Kg}^\circ\text{C}$) [8 marks]

SECTION D: True False with Explanations

Total Marks: 8 marks

You are to circle those you think are correct as true but those you find false you must explain why it is false (what is the correct concept) on a separate sheet of paper

T  F  1. Adding heat does not always cause an increase in temperature

T  F  2. Latent heat of fusion is calculated by using the quantity of heat divided by the mass of the substance

T  F  3. Latent heat of vaporization is the heat required to melt 1 Kg of matter with no change in temperature

T  F  4. Heat capacity can be calculated by taking the quality of heat and dividing by the change in temperature

T  F  5. Heat capacity is the amount required to raise the temperature of 1 Kg of matter by 1° C
Science Quiz #

LAB SAFETY

Name ____________ Date ____________

MARK ____________ 40 = ____________

1. Who is the biggest danger in the lab? (1)
2. No experiment should be attempted without your _________ ________
   and your __________________________ in the classroom. (4)
3. Is it important for a person who wears regular eyeglasses to wear
   approved safety goggles? ________ Why? (1+2=3)

4. State three things you should NEVER do in the lab. (2x3=6)
   1.
   2.
   3.

5. What is one of the most common injuries suffered in the lab? State
   one precaution that will prevent such an injury. (1+2=3)

6. State three precautions a keen grade nine students would follow
   in order to prevent injuries due to explosions. (6)

7. What are three rules to follow if you are using a bunsen burner in
   your experiment? (2x3=6)

8. Explain the proper procedure when mixing a strong acid with water. (2)
Part A Multiple Choice (10 marks)

1. Under a light microscope the size of the objects seen is measured in:
   a) micrometres  b) centimetres  c) millimetres  d) metres

2. A clear ruler marked in millimetres is being used to measure the size of a specimen under a light microscope. Four of the specimen would fit in one millimetre on the ruler. The size of the specimen is:
   a) 1000 μm  b) 250 μm  c) 2.5 cm  d) 25 μm

3. In which of the following organelles is chromatin found?
   a) mitochondria  b) nucleus  c) vacuole  d) ribosome

4. Which of the following organelles is responsible for manufacturing protein in the cell?
   a) lysosomes  b) endoplasmic reticulum  c) ribosomes  d) golgi bodies

5. Osmosis occurs because:
   a) water is going from an area of low concentration to an area of high concentration
   b) water is going from an area of high concentration to an area of low concentration
   c) the pores in one direction block the water molecules and no water can get through
   d) none of the above

6. The asexual form of cell division is called:
   a) asexosis  b) mitosis  c) mitosis  d) none of the above

7. If veggies are placed in fresh water:
   a) their cells will be crisp and turgid because osmosis has occurred
   b) their cells will be limp and turgid because plasmolysis has occurred
   c) their cells will be crisp and flaccid because osmosis has occurred
   d) their cells will be limp and flaccid because plasmolysis has occurred

8. The structure in the plant cell that is made of cellulose is the:
   a) cell wall  b) nucleus  c) chloroplast  d) ribosome

9. Which of the following organelles contain chlorophyll?
   a) lysosomes  b) endoplasmic reticulum  c) chloroplasts  d) ribosomes

10. Organs that work together to perform large complex tasks are called:
    a) tissues  b) organs  c) organ systems  d) organisms
In this sheet, you are to evaluate your performance in the last few minutes of class. Return it completed at the end of the period.

1. Fill in your sheet individually during the last few minutes of class and return it completed at the end of the period.
2. Record a number (0 or 1) in each box to evaluate yourself. You must show these behaviours throughout the entire week or a zero will be recorded.
3. Your teacher will check your entries and correct any that are inaccurate. Your teacher may want you to come in at lunch or after school to discuss points of disagreement.
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5. Lost sheets are your responsibility. THESE SHEETS DO NOT LEAVE THE ROOM.

### (A) Beginning/End of Class

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<th></th>
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<th>Total</th>
</tr>
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<tbody>
<tr>
<td>On time for class with materials ready (pens, notes, etc.)</td>
<td></td>
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</tr>
<tr>
<td>Leaving a clean lab bench or desk</td>
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</table>

### (B) Communication Skills

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</thead>
<tbody>
<tr>
<td>Expressing opinions and ideas clearly</td>
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<tr>
<td>Positive contributions to discussions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### (C) Working Habits

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working consistently without supervision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homework done thoroughly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Showing eagerness to learn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Written work is neat, complete and well organized</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### (D) Social Skills

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showing respect towards others (no &quot;put downs&quot;)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooperative and behaving appropriately</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Showing leadership in group activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not interfering with the learning of peers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Laboratory Participation Checklist - Peer/Self/Teacher

<table>
<thead>
<tr>
<th>Task</th>
<th>Criteria</th>
<th>Beginner</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparatus</td>
<td>Obtains appropriate materials for the experiment or activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set-Up</td>
<td>Helps to assemble the equipment as outlined in the activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean-Up</td>
<td>Helps to dismantle, clean and return apparatus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td>Uses scientific lab procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Safety</td>
<td>Follows all safety rules</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

STUDENT EVALUATOR: ____________________________________________

TEACHER: __________________________ DATE: ____________
### Oral Component:

<table>
<thead>
<tr>
<th>Name:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PRESENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye Contact</td>
</tr>
<tr>
<td>Voice Projection</td>
</tr>
<tr>
<td>Articulation &amp; Inflection</td>
</tr>
<tr>
<td>Posture</td>
</tr>
<tr>
<td>Use of hands</td>
</tr>
<tr>
<td>Enough Information</td>
</tr>
<tr>
<td>Appropriate vocabulary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VISUAL AIDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to understand</td>
</tr>
<tr>
<td>Information is current</td>
</tr>
<tr>
<td>Information is accurate</td>
</tr>
<tr>
<td>Enough Information</td>
</tr>
<tr>
<td>Neatness</td>
</tr>
<tr>
<td>Spelling</td>
</tr>
<tr>
<td>Artistic effort</td>
</tr>
<tr>
<td>Research effort</td>
</tr>
<tr>
<td>Appropriate vocabulary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIOLOGICAL CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information relates to the topic</td>
</tr>
<tr>
<td>Demonstrates a good understanding of biological principles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QUESTION ANSWERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence in knowledge of topic</td>
</tr>
<tr>
<td>Ability to answer reasonable questions</td>
</tr>
<tr>
<td>Willingness to admit limits to knowledge</td>
</tr>
</tbody>
</table>

**TOTAL /21**  
(one mark per item listed)

### Written Component:

<table>
<thead>
<tr>
<th>Name:</th>
</tr>
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</table>

| Marking Schema: |

<table>
<thead>
<tr>
<th>FORMAT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- was there a question posed</td>
</tr>
<tr>
<td>- did it have a purpose, main body, and conclusion</td>
</tr>
<tr>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTENT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- was it 750 words</td>
</tr>
<tr>
<td>- cover page &amp; bibliography (in the proper format)</td>
</tr>
<tr>
<td>- was the purpose achieved</td>
</tr>
<tr>
<td>0 1 2 3 4 5 6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CREATIVITY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- was the approach interesting</td>
</tr>
<tr>
<td>- did the paper show thought &amp; was carefully composed</td>
</tr>
<tr>
<td>0 1 2 3 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMPLETION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- was the rough copy handed in on time</td>
</tr>
<tr>
<td>- were all the due dates met?</td>
</tr>
<tr>
<td>0 1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WRITING:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- spelling, grammar, sentence structure</td>
</tr>
<tr>
<td>- clear, concise ideas</td>
</tr>
<tr>
<td>- logical approach</td>
</tr>
<tr>
<td>0 1 2 3 4 5</td>
</tr>
</tbody>
</table>

**TOTAL**  
25

0 = no attempt was made  
1 = unacceptable  
2 = an attempt was made but very little effort  
3 = satisfactory - good effort to cover area  
4 = well done - majority of criteria covered  
5 & 6 = excellent insight & completion of all criteria for area
| Name __________________________________________ |
| Observation Chart for Science Lab Clean-up |
| 1. All apparatus cleaned up               | Date |
| 2. All apparatus put away                |     |
| 3. Safety procedures followed            |     |
| 4. Gas and water turned off              |     |
| 5. Countertop cleaned & dry              |     |

(✓) if completed
Appendix Q

A Comparative Analysis
of the Ontario Ministry of Education (1987)
Science, Intermediate and Senior Divisions, Part 1:
Program Outline and Policy

and

The Ontario Ministry of Education and Training (1997c)
Key Directions in Secondary Curriculum Development:
A Synthesis of the Recommendations of 24 expert panels

and

Ontario Ministry of Education and Training (1997d)
Key Directions in Secondary Curriculum Development: Science
Key Assessment Features

This curriculum guideline addresses assessment (gathering data) and evaluation (judgment of data). The guideline suggests evaluation be diagnostic (pre-instruction), formative (throughout) and summative (endpoint - unit or course).

Assessment Tools - Diagnostic

Note: Any of the formative or summative tools can be used.

Assessment Tools - Formative

1. Class Tests -
   paper-and-pencil - (multiple choice; true/false; matching; essay; problem solving)
   pictorial - (diagrams; graphing)
   laboratory performance - (following directions to experimental investigation)
   open-book - understanding
   take-home - assignment; project

2. Homework -
3. Laboratory Performances/Reports - criteria checklist
4. Science Notes -
5. Observation - (Try to involve cognitive, psycho-motor, affective)
   Checklist of skills - (Equipment care; lab design + techniques; safety awareness; participation; co-operation)

6. Inventory -
   Questionnaire - (Finding facts, data, opinions)
   Rating scale - (Range of opinions)

7. Performance (Specific motor-skill)
8. Problem Solving - Oral Presentations - Short Projects - Informal Answers
9. Language Usage (observations)
10. Attitude/Behaviour Observations
Assessment Tools - Summative

1. Examinations - Large class and laboratory tests - extended projects
2. Product Analysis -
   - Written Reports (Organization; accuracy; clarity; neatness; completeness; use of language; readability; graphing; diagrams; charts)
   - Science Notes (As above)
   - Projects (As above)
   - Essays (As above)

3. Problem Solving (Application)

Assessment is a combination of diagnostic, formative and summative. Assessment tools may be norm, criterion or self-referenced.

Evaluation includes:
   - **Student Attitudes** (affective domain),
     - 1. Interest (science/technology)
     - 2. Values (nature of science)
     - 3. Respect (environment)
     - 4. Energy (usage awareness)
     - 5. Co-operation (behaviour)
   - **Skills** (psychomotor)
     - 1. Laboratory Skills/Processes
     - 2. Safety (Skills)
     - 3. Field Study Techniques
   - **Knowledge** (cognitive)
     - 1. Recall (information/concepts)
     - 2. Comprehension (new ideas)
     - 3. Application (scientific principles)
     - 4. Analysis/Synthesis (data/explanations)
     - 5. Evaluation (techniques/theories)
     - 6. Problem Solving
     - 7. Communication
     - 8. Decision Making
     - 9. Creative Skills
Key Assessment Features

The expert panel suggests evaluation be diagnostic (pre-instruction), formative (throughout) and summative (endpoint - section, unit or course) and emphasize both process and product.

All work shall be based on clear levels of performance and samples of quality work, so that targets are obvious to students.

Evaluation must be clearly explained and the record of achievement must be useful to students, their parents, the school, postsecondary institutions, and employers.

Assessment of students' performance must accurate, fair, and based on curriculum requirements.

A selection of assessment tools (variety) can be used to assist students with different learning styles.

Assessment Tools - Formative

Tests - Essays - Oral Presentations - Seminars - Student Observations
Portfolios - Simulations - Visual Presentations - Debates - Self-evaluation
Peer-evaluation

Assessment Tools - Summative

Traditional written exam - Oral exam - Final Presentation (demonstration)

Assessment criteria must be understood by students.
Assessment criteria must be consistent with purpose.
Assessment must be based on the demonstration of achievement:
  - cognitive (retain, reproduce, apply knowledge)
  - practical (performance-based),
  - personal /social (teamwork, co-operation, innovation, initiative, originality and time management)

Evaluation and Assessment must allow students to demonstrate practical and critical thinking via drawing conclusions, problem solving, applying skills, analysis, synthesis, and transference to new situations.

Students should keep portfolios to demonstrate achievement.

The Ontario Ministry of Education and Training (1997d)
COMPARATIVE ANALYSIS
(1987 and 1997c,d)

Similarities

1. Each of the documents stresses the importance of diagnostic (pre-instruction), formative (throughout) and summative (endpoint - section, unit or course) assessments that consider both the process and product.

2. Each of the documents stress the importance of assessment in the following areas:

   Student Attitudes (1987 affective - 1997 personal - social)
   - A. Interest (science/technology) (1997- originality)
   - B. Values (nature of science) (1997 - initiative)
   - C. Respect -(environment) (1997- innovation)
   - E. Co-operation (behaviour) (1997- co-operation)

   - A. Laboratory Skills/Processes (1997 - problem-solving)
   - B. Safety (Skills) (1997- same)
   - C. Field Study Techniques (1997- transference/analysis/synthesis)

   Knowledge (1987 cognitive - 1997 cognitive)
   - A. Recall (information/concepts) (1997 - retain)
   - B. Comprehension (new ideas) (1997- retain)
   - C. Application (scientific principles) (1997 apply)
   - D. Analysis/Synthesis (data/explanations)
   - E. Evaluation (techniques/theories)
   - F. Problem Solving (1997- problem solving)
   - G. Communication (1997 - same)
   - H. Decision Making
   - I. Creative Skills

3. Each of the documents stresses the importance of assessing laboratory skills.
4. Each of the documents stresses the importance of a final exam.
5. Each of the documents stresses the importance a variety of assessment tools, such as tests, essays, oral presentations, presentations, self-evaluation peer-evaluation, observations, checklists, notes, and homework.
Key Directions in Secondary Curriculum Development: Science

**Key Assessment Features**

Assessment should be varied and multiple (i.e., weekly) with clear consistent expectations.

**Assessment Tools - Alternative**

- Journal
- Open-ended problems
- Portfolio
- Interviews
- Performance assessments
- Essay
- Multiple choice tests
- Hands-on assessments (STSE focus)

**Assessment Tools - Authentic**

- Process/product - written + observation
- Outcome based

Ongoing assessment is not an end rather, it should be linked to strategies/based on outcomes
Assessment measures student achievement and program effectiveness.

**Assessment Tools - Summative**

- Final Exam - could be practical rather than written and not disproportional to that of other assessments.

Assessment should be based on knowledge, skills and attitudes that comprise science literacy with an STSE focus.
**Differences**

1. The 1997c document emphasizes the teacher's role in communicating clearly the levels of performance and targets (exemplars) to students.
2. The 1997c document emphasizes the teacher's role in communicating clearly the record of achievement and making it useful to students, their parents, the school, postsecondary institutions, and employers (accountability).
3. The 1997c document emphasizes that assessments must be accurate, fair, and based on curriculum requirements.
4. The 1997c,d documents suggest assessment should be varied and multiple (i.e., weekly), with clear consistent expectations.
5. The 1997d document suggests assessment should include alternative modes such as: Journals, open-ended-problems, portfolios, interviews and essays combined with a hands-on STSE focus.
6. The 1997d document suggests the final exam could be practical rather than written and not disproportional (too high a percentage of the course grade - weighting) to that of other assessments.
7. The 1997c document suggests assessments take the form of seminars, student observations, simulations and debates.
8. The 1997c document prominently emphasizes that assessments take the form of self and peer-evaluation.
9. The 1987 document mandates a specific 15% for laboratory work and another 40 to 50% for actually carrying out an action such as observing, identifying, performing, constructing, demonstrating, balancing, collecting, interpreting, using, recording, writing, presenting, drawing, participating, assembling, connecting, measuring, predicting and the like.
10. The 1997cd documents do not specify percentages for types of assessment yet they do suggest the final exam not be disproportional to that of other assessments.

In sum, while there are many similarities between the 1987 and the 1997 documents, there are also some important differences. The 1997 documents seem to emphasize more often the need for the clear and consistent communication of expectations, directions and understanding of assessment for each consumer's (students, parents, community) benefit. As well, a need for accurate, fair and understandable modes of assessment predominates in 1997. Suggested assessments are more varied, authentic and of an alternative nature, all the while embracing an STSE focus.
Appendix R

Models of Action Research

R-1, R-2, R-3, R-4, R-5
Kurt Lewin's model of action research as interpreted by Kemmis (1980).
A revised version of Lewin’s model of action research.
My enquiry questioning is disrupted by my need to keep control in ways the class expects.

Record questions and responses on tape for a couple of lessons to see what is happening. Keep notes of my impressions in a diary.

Enquiry developing but students are more unruly. How can I keep them on track? By listening to each other, probing their questions? What lessons help?

Record on tape questioning and control statements. Note in diary effects on student behaviour.


Shift questioning strategy to encourage students to explore answers to their own questions.

Try questions which let students say what they mean, what interests them.

Continue general aim but reduce number of control statements.

Use less control statements for a couple of lessons.

The ‘action research spiral’ (based on Kemmis and McTaggart 1988a)
McKernan's action research model (from McKernan 1991: 29).
Idealized representation of the process of action research

Fig. 4.3 Ebbutt's model.